

# Propolis: Composition, Health, Medicine: A Review

*Other bees, like soldiers, armed in their stings,  
Make boot upon the summer's velvet buds,  
Which pillage they with merry march bring home.*

Shakespeare, King Henry



## PROPOLIS IN HISTORY



The word propolis originates from Greek: «pro» = in front, «polis» = city. The meaning „ in front of the city,, suits well the protecting role of propolis for the bee colony. The Greek word propolis means also to glue and describes also the role of propolis to cement openings of the bee hive. Another name of propolis is bee glue.

Bee gather propolis from different plants, in the temperate climate zone mainly from poplar. In Brazil, a major propolis producer, the main propolis type is the green propolis from Baccharis. You can find more on the collection of different types of propolis, its use, quality, trade and application forms (with many practical recipes) in the illustrated Propolis Books online at [www.bee-hexagon.net](http://www.bee-hexagon.net).

## COMPOSITION

Table 1 A: **Composition of raw poplar propolis** after <sup>18, 20, 45, 108, 172, 175, 218</sup>

	Substances
<b>BALSAM</b> 40-60 % Ethanol soluble Poplar origin	<i>Phenolics</i> Phenols, phenolic acids, esters, flavanons, dihydroflavanons, flavons, flavonols, chalkones, phenolic glycerides ; <i>Others:</i> Aliphatic and phenolic acids, alcohols, esters, aldehydes, ketones.
Essential oils 3-5 % ethanol soluble poplar origin	Mono-, and sesquiterpenes
<b>NON-BALSAM</b> Wax: 20-35 % Ethanol insoluble Beeswax origin	Beeswax components
others: ca. 5 % partly ethanol soluble bee and pollen origin	Mainly minerals average ash content 2.1 % Polysaccharides:2 % Proteins, amino acids, amines and amides: 0. 7 % Traces of carbohydrates, lactones, quinons, benzoic acid and esters, steroids, vitamins

Table 1 B: **Composition of raw Baccharis propolis** after <sup>35, 44, 118, 165, 166, 185</sup>

	Substances
<b>BALSAM</b> 45 -60 % Ethanol soluble Baccharis origin	Mainly cinnamic acid and derivatives, coumaric acid, prenylated compounds, artemillin C Minor quantities of phenolics as flavonoids, benzoic acid, aliphatic acids and esters
<b>NON BALSAM</b>	
10-15 % Ethanol insoluble Baccharis origin	prenylated compounds, alkanes and terpenoids
15-25 Ethanol insoluble Beeswax origin	Beeswax
ca. 5 % partly ethanol soluble Bee and pollen origin	2.5 – 4.5 % minerals 1-2 % of carbohydrates: fructose, mannose, inositol, erythrose 1-2 %: glycerol, lower aliphatic acids, amino acids, amines

Propolis is composed mainly by the plant resins and exudates that bees gather. Bees add wax, and also some secretions and pollen to it. The composition of propolis depends on its botanical and thus also on its geographical origin.

Several hundred different compounds have been characterised in the different propolis types. The typical components of poplar propolis are the phenolics: flavonoid aglycones, (flavones and flavanones), phenolic acids and their esters. The typical compounds of Brazilian propolis are prenylated derivatives of p-coumaric acid and of acetophenone, as well as diterpenes and lignans. The flavonoids are different from those in 'poplar type' propolis.

The overall content of this propolis type is similar to the poplar propolis, basically containing balsamic and non balsamic components. It contains a main part of plant derived substances and minor part of bee and pollen derived substances. The chemical composition is, however very different.

The balsam part of poplar propolis originates from the collected glue, while the non-balsamic constituents are added by the bees.

The non-ethanol soluble part of the Baccharis propolis originating partly from the plant, besides a part of minor constituents originating partly from the plants and from the bees and from pollen.

## COMPOSITION AND NUTRITIONAL REQUIREMENTS

The composition of propolis is given in the **Propolis Quality** report. The nutrient relevant components of propolis are about 5 % of the total propolis and have been generally determined qualitatively and semi-quantitatively. Approximate figures, estimated from the qualitative data from the literature

Proteins: approx 1 g/100 g

Carbohydrates: approx. 1 g/100 g

Fat: approx: 1 g/100 g

*Considering the low suggested intake of 200 mg per day propolis has an insignificant contribution to the daily requirements regarding the basic nutrients.*

## HEALTH ENHANCING EFFECTS

Hundreds of publications have appeared in the last 40 years describing the biological and health enhancing properties of propolis. The health enhancing effects are divided into main and secondary effects. This division has been made taking into consideration the number of publications and the health significance of the effect. The health enhancing effects are found in the ethanol extractable part of propolis is called balsam. The

biological activity of ethanol extracts is generally tested with 70 to 100 % ethanol extracts. 60-80 % aqueous ethanol solutions have a higher biological activity than tinctures, prepared with more or less water<sup>159, 160</sup>

The different biological and health enhancing effects, as tested in cell experiments and animals are summarised on table 1. ) The effects described here were achieved in cell and animal experiments. A number of reviews have summarised the knowledge on propolis<sup>23, 33, 119, 147</sup>.

**Table 2: Biological and health enhancing properties of propolis as tested in cell cultures and animal experiments**

Effect	Tested propolis type	Reference
Antibacterial	All propolis types	23, 33, 61, 110, 119, 194
<b>Main functional effects</b>		
Antiviral	All propolis types	23, 33, 61, 110, 119, 194
Antifungal	All propolis types	23, 33, 61, 110, 119, 194
Against parasites	Poplar, Baccharis, Cuba	49, 55, 151, 170, 219
Antiulcer (stomach, skin, buccal)	Baccharis, India	24, 37, 47, 48, 84, 155, 168, 194
Antioxidant	All propolis types	23, 33, 61, 61, 119
Radiation protective	Poplar, Baccharis	27, 28, 65, 147, 209
Hepatoprotective	All propolis types	21-23, 61
Antitumor, antimutagenic Cyto- and chemopreventive	Poplar, Baccharis, Cuba, Taiwan,	23, 33, 51, 87, 119, 147, 171, 227 27, 28, 147, 213
Antiinflammatory	Poplar, Baccharis, Cuba, Egypt	5, 23, 101, 158, 161, 177, 180, 205
Immunomodulation (immunostimulating)	Poplar, Baccharis	23, 61, 147, 193
Muscle contracting at small concentration Muscle relaxant at higher concentration	Poplar, Baccharis	9, 43, 56, 98, 162, 210
Antidiabetes	Poplar, Baccharis	2, 96, 123, 194, 229, 232
Cardioprotective: antimyocard, antithrombogenic, antihypertensive, antiarrhythmic	Poplar, Bacharis, Asia,	6, 37, 41, 41, 61, 84, 86, 133, 143, 155
Local anaesthetic	Poplar, Bacharis	157, 218, 221 196
Improves regeneration of cartilagnious and bone tissue, dental pulp, cicatrising	Poplar, Baccharis	73, 191, 192, 212, 218
<b>Secondary effects</b>		
Anti-osteoporose	Poplar, Egypt	8, 57
Against scratching behaviour in mice	Baccharis	196
Estrogenic	Poplar	204
Against experimental rhinitis in mice	Baccharis	197
Against experimental colitis in rats	Popplar, Turkey	10
Against rat colon anastomosis in rats	Popplar, Turkey	102
Angiostatic effect in human umbilical vein endothelial cells	Baccharis	40, 94
Anti-allergenic	Poplar, Bacharis	140, 193, 214
No effect on basic blood parameters, protects erythrocytes against radiation, anti-aggregation effect;	Poplar, Baccharis	9, 195
Protects sperm membrane from the deleterious action of oxidative attack	Chile	182
Neurotrophic effects Artepillin C in PC12m3 cells	Baccharis	97
Inhibits cell growth of higher plants and animals inhibits germination of wheat seedlings	Poplar	9, 206
Water-soluble propolis derivative relieves scopolamine-induced amnesia in mice	Poplar	36
Enhancement of the hyperthermal tolerance in immune mononuclear cells of competitive cyclists	Poplar (CAPE)	38
Food preservative	Poplar, Baccharis, Argentine, Egypt	1, 4, 11, 104, 136, 184, 201, 220

Most studies have been carried out with poplar and Baccharis propolis, while in some of them the propolis type was not determined. It is astonishing, that while the composition of the different type of propolis differs greatly depending on its botanical origin, the biological effects of the different propolis types are very similar. Also, the active ingredients for these effects are different in the different types of propolis (table 2).

The main propolis types on the market are poplar and Baccharis propolis. These two types of propolis have similar biological properties but the active ingredients are different (table 3)

Table 3 **Biological effects of propolis components**

Component, propolis type	Biological Activity	Reference
Polyphenols and flavonoids Mostly poplar, but present in most propolis types	Antibacterial, antiviral, antifungal, antioxidant, antiaging, antiulcer, antitumor, antiallergic, antiinflammatory, antiosteoporotic, antitrombogenic, antiatherosclerosis, cardioprotective, immunomodulating, hepatoprotective, sicutrising	5, 23, 33, 68, 77, 79, 116, 119, 141, 163, 177, 193
Caffeic acid phenethyl ester (CAPE) and other caffeates Mostly poplar	Antioxidant, anti-inflammatory, antitumor, antibacterial, antiviral, fungicide, immunomodulatory, cardioprotective, hepatoprotective, antiosteoporosis	13, 16, 8, 61
Caffeic acid (CA) Poplar, Baccharis	Antiviral, Antioxidant, antiulcer, antitumor	61
Polyprenylated benzophenones Cuba, Venezuela and Brazil	Antioxidant, antiinflammatory, antitumor	13, 16
Artepillin C Baccharis	Antioxidant, antiinflammatory, antitumor, apoptosis inducing	13, 16
Prenylated flavanones (propolins) Taiwan	Antioxidant, anticancer, apoptosis inducing,	13, 16
Terpenes Greece, Crete, Croatia, Brazil	antibacterial, antifungal	14, 15, 29, 124, 124, 173
Essential oils Brazil, Poland	antibacterial	17, 46, 233
Furfuran lignans Canary islands	antibacterial	42

Table 4: **Biologically active ingredients in Poplar and Baccharis propolis**

Biological activity	Propolis type, active ingredient	Ref.
Antibacterial	Poplar: different flavonones, flavons, phenolic acids and their esters Baccharis: prenylated p-coumaric acids, labdane diterpenes	12, 61, 109 12, 15, 120
Antifungal	Poplar: pinocembrin, galangin, benzoic acid, salicylic acid, vanillin Baccharis: mono and sesquiterpenes, Artipellin C	63, 128 63
Antiviral	Poplar: Polyphenols, phenyl- carboxylic acids, and esters of substituted cinnamic acids, caffeic acid, quercetin, luteolin, fisetin, quertecagetin, Baccharis: activity detected but no substances identified	61, 105 32, 110
Antioxidant Radiation protective	Poplar: different flavonoids phenolics and their esters Baccharis: different prenylated p-coumaric acids and flavonoids	12, 61, 111 12, 61, 111
Hepatoprotective	Poplar: different flavonoids, CAPE, ferulic acid, caffeic acid Baccharis: different prenylated p-coumaric acids, flavonoids, lignans	12, 61, 111 19, 61
Anticancer and antitumor	Poplar: CAPE, caffeic acid, caffeic acid phenylethyl ester, apigenin, quercetin, genistein Baccharis: artipelline C, baccharin, drupanin, cinamic acid derivatives, prenylated p-coumaric acids, clerodane diterpenes, benzofuranes	12, 61, 147 12, 61, 147
Immuno modulating	Poplar: CAPE, chriysin, benzylcaffeate, phenethylferrulate, cinamic acid Baccharis: caffeoylquinic acid derivatives, clerodane diterpenoid, artipelline C	67, 93, 193 193, 215
Anti-inflammatory	Poplar: Flavonons, flavons, phenolic acids and their esters Baccharis: artipelline C	12, 61 161
Cardioprotective	Poplar: CAPE, acacetin, chrysin, quercetin Baccharis: caffeoylquinic acid	61 133
Anti-ulcer	Poplar: Caffeic acid, pinocembrin, galangin, chrysin Baccharis: ferulic, p-coumaric and cinnamic acids,	61, 92 61

## Propolis against bacteria, fungi, molds and parasites

The antimicrobial activity of propolis is by far the most important biological property of propolis, which has deserved the highest scientific interest, considering the high number of performed studies. Around 700 hundred papers deal with this aspect. In spite of the big compositional differences of the different propolis types, they all have antimicrobial activity. It seems that rather the sum of the propolis antimicrobial components than individual substances are responsible for the antimicrobial action<sup>110</sup>.

### Antibacterial activity

Table 5 : Effects of propolis against pathogenic and harmful bacteria funghi, viruses, molds and parasites after<sup>23, 33, 68, 119, 218</sup>

#### Gram-positive bacteria

*Bacillus cereus*, *Bacillus mesentericus*, *Corynebacterium spp.*, *Corynebacterium diphtheriae*, *Diplococcus pneumoniae*, *Enterococcus spp.*, *Mycobacteria sp.*, *Mycobacterium tuberculosis*, *Staphylococcus aureus*, *Streptococcus: criticus epidermis faecalis mutans, pyogenes, viridans, sobrinus*,

#### Gram negative bacteria

*Branhamella catarrhalis*, *E. coli*, *Helicobacter pylori*, *Klebsiella ozaemae*, *Proteus vulgaris*, *Pseudomonas aeruginosa*, *Salmonella: choleraesuis, dublin, enteritidis, exneri, gallinarum, pullorum, , paratyphi-A, paratyphi-B, typh;i Shigella: dysinteriae, sonnei*

#### Fungi

*Aspergillus sp.*, *Candida: albicans, guiliermondi, parapsilosis, tropicalis*; *Cryptococcus sp.*, *Cryptococcus neoformans*, *Histoplasma encapsulatum*, *Madurella mycetomi*, *Microsporium: audoinini, canis, cepleo, distortum, ferrugineum, gypseum*; *Piedra hortae*, *Phialophora jeanselmei*, *Saccharomyces sp. , Trichophyton: sp., mentagrophytes, rubrum, Trichosporon cutaneum*

#### Viruses

Adenovirus, Coronavirus, Herpes symplex, Influenza A and B, Newcastle disease, Polio virus, Vaccinia, Rotavirus; Vesicular Stomatitis Virus, Coronar virus

#### Parasites

*Cholomonas paramecium*, *Eimeria: magna, media, perforans*;  
*Giardia lambia*, *Trichomonas vaginalis*, *Trypanosoma cruzi*

Propolis is the bee product with the highest antimicrobial activity. The antibacterial activity of propolis has been confirmed by numerous scientific studies. Antibacterial activity has been demonstrated against both gram positive and and gram-positivite, both aerobic and anaerobic types.

Although the composition of propolis differs considerably depending on its botanical origin, all examined types of propolis revealed a strong antibacterial activity<sup>12, 16</sup> The antibacterial activity of poplar propolis and other types of propolis of different geographical and botanical origin was similar<sup>110</sup>.

Poplar propolis gathered by by *Apis mellifera caucasica* had a higher antibacterial activity than the one gathered by *Apis mellifera anatolica* and *Apis mellifera carnica*<sup>202</sup>

The antibacterial activity of propolis to pathogenic or harmful bacteria is summarised in the table below<sup>23, 33, 68, 72, 119</sup> It has been proposed that propolis is more active against gram-positive pathogens<sup>72</sup> but many gram negative bacteria are also inhibited (see table).

More recent research has revealed antibacterial activity against *Micrococcus luteus*, *Salmonella typhimurium*<sup>223</sup> *Klesbsiella pneumoniae*<sup>224</sup>. Although in previous studies<sup>72</sup> it was claimed that *Listeria monocytogenes* is not sensitive to propolis, recent works revealed significant antibacterial activity<sup>154, 228</sup>. In recent study it has been shown that propolis has a stong antibacterial activity against 13 different plant pathogens<sup>26</sup>.

With the increasing of antibiotic resistance in the last years there is a considerable interest of hospitals in propolis as an antibacterial agent. It has been shown that propolis has synergistic effects with antibiotic action against bacteria<sup>119, 145, 146, 189, 208, 211</sup>.

The antibacterial effect of propolis is bactericidal, that means bacteria-killing,<sup>72, 132, 164</sup> by inhibiting their mobility<sup>132</sup>. Each propolis type has different antibacterial substances in propolis (see table 5). The antibacterial substances of the two main propolis types are given in table 6.

Generally biological activity decreases with increasing storage. However it was found that propolis solution in ethanol stored for 10-15 years results not in a decrease, but in an increase of antibacterial activity<sup>126</sup>.

### **Antifungal, antiviral and anti-parasitic activity**

Poplar propolis is the bee product with the highest antifungal activity as tested with 40 yeast strains of *Candida albicans*, *Candida glabrata*, *Candida krusei*, and *Trichosporon spp.*<sup>103</sup>

Poplar propolis gathered by *Apis mellifera caucasica* in Turkey had higher antifungal activity than the one gathered by *Apis mellifera anatolica* and *Apis mellifera carnica*<sup>200</sup>. On the other hand the antifungal and mostly antiviral properties of propolis from different botanical and geographical origin was similar<sup>110</sup>.

Recent research on the of propolis have shown fungicide effects on juice spoilage fungi *Candida famata*, *C. glabrata*, *C. kefyr*, *C. pelliculosa*, *C. parapsilosis* and *Pichia ohmeri*<sup>104</sup>.

Propolis kills the fungi and also the viruses, while the growth of the latter is also inhibited<sup>119</sup>.

The results summarised above show that propolis has antibacterial, fungicide, antiviral and antiparasitic effects of against harmful and pathogen organisms. These properties make it a good candidate for its application in therapy (see section apitherapy).

### **Antioxidant and hepatoprotective activity**

#### **Antioxidant activity**

An antioxidant is a molecule capable of slowing or preventing the oxidation of other molecules and so to prevent such changes. The antioxidant effect correlates roughly with the anti-inflammatory and hepatoprotective activity.

Although the phenolic content seems to vary according to the botanical origin, antioxidant effects for most propolis types have been reported.

Compared to pollen and royal jelly, propolis extracts exhibited the highest antioxidant activity<sup>139</sup>.

In a study with propolis of different geographical and botanical origin it was found that the antioxidant activity correlates well with its total concentration of polyphenols<sup>111, 127</sup>. Poplar propolis with relatively higher polyphenol content has a higher antioxidant activity than Brazilian propolis, which contains less polyphenols<sup>107, 111, 112</sup>.

The antioxidant activity differs on the type of the polyphenols. CAPE, a typical constituent of poplar propolis, seems to be one of the most powerful antioxidant substances of propolis<sup>61</sup>.

The antioxidant activity is measured in different units. The antioxidant activity of different foods is compared mostly the so called ORAC (Oxygen Radical Absorbance Capacity) index. According to a 2007 US Patent a 50/50 water/acetone extract of poplar propolis scored 2459 ORAC units, while a hexane/ethylacetate (75:25) scored 7215 ORAC units. Pure propolis resin scored 9674 ORAC units ( $\mu\text{mole TE/g}$ )<sup>88</sup>.

10 % ethanol poplar propolis extract from Croatia had about 70 % of the FRAP antioxidant activity of known antioxidants as vitamin C and trilox. Propolis modulated antioxidant enzymes (AOE) and significantly decreased lipid peroxidation processes (LPO) in plasma, liver, lungs, and brain of mice. The effect was dose- and tissue-dependent. The highest vulnerability to oxidative stress was observed in lungs where hyperoxia was not associated with augmentation of AOE. Propolis protected lungs from hyperoxia by increased catalase (CAT) activity. This is of special importance for lungs since lungs of adult animals are highly vulnerable to oxidative stress because of their inability to augment AOE activity. The authors conclude that because of its strong antioxidant and scavenging abilities, native propolis might be used as a strong plant-based antioxidant effective not only in physiological conditions but also in cases that require prolonged high concentration of oxygen<sup>203</sup>.

***Propolis is a powerful antioxidant. This effect is due to the high concentration of phenolics and other antioxidant compounds. The radical theory in human physiology claims that the active free radicals are involved in almost all the cellular degradation process and leads to cell death. Oxidative stress is thought to contribute to the development of chronic and degenerative diseases such as cancer, autoimmune disorders, aging, cataract, rheumatoid arthritis, cardiovascular and neurodegenerative diseases<sup>167</sup>. Propolis can be regarded as a supplement preventing chronic degeneration diseases, e.g. cancer.***

#### **Hepatoprotective activity and anti-radiation activity**

The liver is perhaps the hardest working organ of the body. It has hundreds of tasks to perform, including detoxification of the blood. A sluggish liver means fatigue and toxemia and a high risk of various chronic

diseases. Phenolics are known to have a hepatoprotective function. Hepatoprotective activity for different types of propolis has been reported, which correlated to the antioxidant activity<sup>21-23</sup>. Propolis counteracts hepatotoxic effects of alcohol liver injury in mice<sup>114, 178</sup> and also of paracetamol induced liver damage of mice<sup>71</sup> and carbon tetrachloride induced liver damages in rats<sup>70</sup>.

The anti-radiation effect of propolis have been reviewed by Orsolich. As an antioxidant propolis has a powerful effect to counteract radiation as tested in tumor cells or animals. Propolis act also in apoptotic of cancer cells thus improving the anti-cancer effect or radiation<sup>147</sup>

***Propolis supplementation is prophylactic for liver health and for counteracting the damaging effect of tumor irradiation.***

## **Immunomodulating effects**

The immunomodulating effect has been reviewed in 2007 by Sforcin<sup>193</sup>. All propolis types have immunostimulating activity (see table 3). However the active substances the various types of propolis are different (table 5 and 6).

### **Action on microphages**

In vitro and in vivo assays demonstrated the modulatory action of propolis on murine peritoneal macrophages, increasing their microbicidal activity and stimulating the lytic activity of natural killer cells against tumor cells by enhancing antibody production. The best immunostimulating results were observed when propolis was administered over a short-term to animals. Both poplar and Baccharis propolis increase the microphage activity<sup>193</sup>

### **Action on lymphocytes and antibody production**

Both poplar and Baccharis propolis can have an immunostimulating effect by increasing antibody production and by activating B and T lymphocytes, an adjuvant like activity of propolis<sup>193</sup>.

***Propolis can be regarded as a supplement for the stimulation of the immune system.***

## **Antitumor effects**

The antitumor activity of propolis was reviewed by Orsolich in 2010: The chemopreventive activity of propolis in animal models and cell cultures are likely to be the result of their ability to inhibit DNA synthesis in tumour cells, their capability to induce apoptosis of tumour cells, and their property to activate macrophages to produce factors capable of regulating the function of B-, T- and NK-cells, respectively. Moreover, these results suggest that flavonoids from propolis play a protective role against the toxicity of the chemotherapeutic agents or radiation in mice, giving hope that they may have similar protective action in humans. The combination with an adjuvant antioxidant therapy may enhance the effectiveness of chemotherapy by ameliorating the side effect on leukocytes, liver and kidneys and consequently enabling dose escalation<sup>147</sup>

Although many polyphenols have a anti-metastatic activity, caffeic acid phenethyl ester (CAPE) from poplar propolis and Artepillin C from Baccharis propolis have been identified as the most potent antitumor agents<sup>3, 13, 16, 148, 149, 193</sup>

***Regular consumption of propolis food supplements can have a preventive effect against mutation linked cancers in humans***<sup>179</sup>

## **Anti-inflammatory activity**

Inflammation (inflammatio, to set on fire) is the complex biological response of vascular tissues to harmful stimuli, such as pathogens, damaged cells, irritants and free radicals. Antiinflammatory activity is thus defined as the primary effect of the host defence system.

The antiinflammatory activity of propolis has been reviewed by Almeida and Menezes. Propolis has inhibitory effects on mieloperoxidase activity, NADPH-oxidase ornithine decarboxilase, tirosine-protein-kinase, and hyaluronidase from guinea pig mast cells. This anti-inflammatory activity can be explained by the presence of active flavonoids and cinnamic acid derivatives. The former includes acacetin, quercetin, and naringenin the latter includes caffeic acid phenyl ester (CAPE) and caffeic acid (CA)<sup>5</sup>

CAPE and galangin, both typical poplar propolis constituents exhibited anti-inflammatory activity and significantly inhibited carrageenan oedema, carrageenan pleurisy and adjuvant arthritis inflammations in rats<sup>30, 52</sup>. An ethanol extract of propolis suppressed prostaglandin and leukotriene generation by mouse peritoneal macrophages in vitro and during zymosan-induced acute peritoneal inflammation in vivo. Dietary propolis

significantly suppressed the lipoxygenase pathway of arachidonic acid metabolism during inflammation in vivo. CAPE was a more potent modulator of arachidonic acid metabolism than caffeic acid, quercetin and naringenin<sup>131</sup>.

***Propolis can be regarded as food supplement for counteracting body inflammation***

## APPLICATIONS IN MEDICINE

Table 6: Health enhancing effects tested in human cells or in humans

Study, effect	Propolis type	Reference
<b>Cell and tissue experiments</b>		
Antiproliferative activity in many different human cancer cells	All propolis types	147, 193
Antioxidant and antiproliferative activity in human B (human mouth epidermoid carcinoma cells), Caco-2 (colon adenocarcinoma cells) and DU-145 (androgen-insensitive prostate cancer cells)	Chile (poplar)	181
Propolis has protective action against oxidative modification of lipids in human unfractionated serum	Argentina	91
Propolis may have a role in protection against male infertility	Chile (poplar)	182
Propolis extracts and CAPE have protective action of propolis in cartilage tissue alteration, that appears greater than that elicited by indomethacin, commonly employed in joint diseases	Italy (poplar)	34
Dressing of artificially formed losses of the cartilaginous tissue with the preparation containing ethanol extract of propolis (EEP) caused acceleration of regenerating processes in the lesioned cartilage. EEP inserted into the joint is well tolerated	Poland (poplar)	192
10% propolis was a more effective storage medium for human periodontal ligament cells than other tested media and is a suitable transport medium for avulsed teeth	Turkey (poplar)	150
<b>Clinical studies</b>		
Successfully applied against the different stomatological pathologic conditions: stomatitis, paradontosis, gingivitis and caries	Poplar and Baccharis	7, 81, 106, 115, 115, 122, 144, 186, 218
Use of combined therapy with propolis and antibiotic against <i>Helicobacter pylori</i> in humans, better efficiency than antibiotic alone	Italy, Poland (poplar)	142, 169
Propolis was successfully used in patients operated for goitre, patients with wounds and ulcerations difficult to heal and patients with non-specific rectal inflammation.	Poland (poplar)	78
A total of 260 steel workers suffering from bronchitis were successfully treated for 24 days with an ethanolic extract of propolis (EEP) in a physiological salt solution.	Poland (poplar)	190
CAPE-rich water-miscible extract propolis suppressed completely the growth of a human NF1 cancer called MPNST (malignant peripheral nerve sheath tumor) and caused an almost complete regression of human NF2 tumor (Schwannoma), both grafted in nude mice.	New Zealand (poplar)	50
Successful treatment of human giardiasis (intestinal parasitism)	Cuba	134
In vivo effect in healthy (n=49), Effect gender specific (only in men) For the men test group after the initial 15 days of propolis treatment, 23.2% (p = 0.005) decrease in concentration of malondialdehyde was observed. No effects in women	Croatia (poplar)	95
Clinical study for the treatment of bronchial asthma with 22 patients receiving a propolis supplement and 24 with a placebo control: a substantial improvement of conditions in treatment group, accompanied by drop of proinflammatory cytokines	Egypt	100
It was found that propolis decreases the erythrocytes membrane fragility of patients with hereditary spherocytosis red blood cells. The results obtained in vitro suggest that the membrane fragility increases under oxidative stress conditions for the patient RBC's and the protection effect of propolis is due to its antioxidant properties.	Two Brazilian propolis types	138

The main medical application of propolis are based on its antimicrobial, antiinflammatory and immunomodulating effects: e.g. ins stomatology, otorhinolaryngologic diseases, gastroenterology, gynecology, pediatric, urological and surgical diseases. It has also potential in other medical fields such as cancerology, dermatology, endocrinology, where the other biological effects of propolis also play a role.

The medicinal effects of propolis are summarised in table 5, as available in original publications.

## **Stomatology and odontology**

The application of propolis in stomatology is probably the most well scientifically documented and now practically applied in many countries, mostly the developing ones.

Propolis is very widely used in dentistry<sup>144</sup>. Propolis inhibits in the mouth different pathogenic microbes such as bacteria, fungi and viruses<sup>81, 187, 188, 199</sup> and can be successfully applied against the different stomatological pathologic conditions: stomatitis, paradontosis, gingivitis and caries<sup>7, 81, 106, 115, 115, 122, 144, 186, 218</sup>.

For this purpose propolis is applied in form of spray, mouthwashes (both with or without alcohol), toothpastes

## **Otorhinolaryngologic and respiration diseases** (ear, nose, throat, and head and neck disorders)

This topic has been reviewed by Marcucci<sup>119</sup>, Asavova<sup>9</sup>, Shkenderov-Ivanov<sup>198</sup> and Tichonov<sup>218</sup>

Following diseases have been treated, given are also the number of cited studies:

- Chronic and acute inflammation of the inner ear: 10
- Common acute cold, acute and chronic inflammation of the upper respiration path: 13
- Synositis: 3
- Laryngitis (larynx inflammation): 2
- Tonsillitis (infections of the tonsils): 4
- Pulmonary tuberculosis: 5 (sometimes together with antibiotics and together in complex of anti-tuberculosis measures)
- Bronchial asthma: 3

A total of 260 steel workers suffering from bronchitis were treated for 24 days by various methods including local and systemic regulation of the immune system and local treatment with an ethanolic extract of propolis (EEP) in a physiological salt solution. The best results were obtained in patients treated with EEP inhalations<sup>190</sup>. For the otorhinolaryngologic (ear, nose, throat) treatments following application forms have been used:

- Common acute cold, acute and chronic inflammation of the upper respiration path, synositis, bronchial asthma: *aerosol inhalation combined with EEP intake*
- Inflammation of the inner ear: *tampons and washing with propolis extracts*
- Tonsillitis: *aerosol inhalation, application of propolis ointments*

### **Application forms**

- Propolis inhalation 3 to 5 times a day
- Drops (10-15 drops of 20 % propolis, 3 times a day) or
- Tablets: 4-6 times daily of tablets containing 50 mg propolis

Cream and ointments containing 5-10 % propolis

## **Gastroenterology**

From the different effects reported in table 5 and 6 the most widely mentioned are the ones concerning the effects of propolis in gastroenterology. Propolis is known as a powerful inhibitor of *Helicobacter pylori*, the causative agent of gastric, duodenal ulcers and gastritis<sup>21, 53, 92, 231</sup> and it was used alone<sup>115, 218</sup> or in combination with antibiotics for in the prevention and treatment of gastric ulcers<sup>21, 53, 231</sup>.

***Due to its antiinflammatory and antimicrobial properties propolis supplements can be used for the prevention of bacterial infection and of inflammation of the stomach and duodenum.***

## **Propolis against cancer**

This promising area has been reviewed by Galvao et al.<sup>66</sup> and quite recently (2010) by Orsolich<sup>147</sup>. There are many cell culture and animals demonstrating antitumor effects in different cancers. Thus regular propolis consumption could have a preventive anticancer effect<sup>179</sup>.

On the other hand, there are very few human studies. One major threat for women is the human papilloma virus (HPV) infection which can lead to cervical cancer, which is the most frequent cancer in women, especially in

the developing world. But even in Western countries there are many HPV-associated dysplasias which require surgery by means of conisation or even hysterectomy. Two studies have shown that propolis-containing local therapy can eradicate HPV infections within six months. In a randomised trial, HPV infections were present after three months of treatment in 28% of patients treated with propolis compared to 90% in the control group<sup>89</sup>. Similarly, another study described an improvement in PAP smears of 76% with the use of propolis<sup>90</sup>. Here, treatment with bee products offers an interesting approach which could avoid invasive surgery.

CAPE-rich water-miscible extract propolis suppressed completely the growth of a human NF1 cancer called MPNST (malignant peripheral nerve sheath tumor) and caused an almost complete regression of human NF2 tumor (Schwannoma), both grafted in nude mice. The same preparation is currently tested on patients<sup>50, 129</sup>

Regular consumption of propolis food supplements can have a preventive effect against mutation linked cancers in humans<sup>179</sup>

## The experience of Ludyanski

Ludyansky, a chief doctor in a big Russian hospital, with life-long practice in apitherapy, has summarised the apitherapy knowledge in his monograph “Apitherapia” (in Russian)<sup>115</sup>. He summarises the medical uses of propolis in his hospital in the following table:

Table 7. Applications of propolis in a big Russian hospital

Treated disease	Very good and good improvement	No improvement
Alopecia	69	10
Geriatry	22	10
Impotency	20	2
Inflammation of the vagina	26	9
Pediatrics	100	-
Prostatitis	13	5
Radiculitis, polyradiculoneuritis	39	2
Stomach ulcer	23	5
Stomatology	16	3

## 5. EXTERNAL APPLICATIONS: SKIN LESIONS, SURGERY, WOUNDS, BURNS, ULCERS, SKIN AND EYE DISEASES, GYNECOLOGY

### Skin lesions, surgery, wounds, burns, ulcers

Propolis applications in this area are known since ancient times and are based on its antimicrobial and anti-inflammatory properties. This area has been recently reviewed by Barbosa<sup>25</sup>, “In this review 4 studies on the successful use of propolis in skin lesions such as ischemic ulcer, stasis ulcer, venous ulcer, iatrogenic lesion and ulcer were reported. Applied was 30 % aqueous propolis extract. After the first week of use already, improvement of wound odor and patient’s sensitivity to pain was observed, as well as a decrease in the number of microorganisms. The authors of this study emphasized that wound healing efficacy is closely associated with the propolis concentration in the solution. Another study, which used propolis ointment on 22 chronic wounds, of which 11 were venous ulcers, seven pressure ulcers, two diabetic ulcers, and two post-trauma injuries, found that necrotic tissue was present in 14 (8.2%) during tissue assessment process. However, there was no necrotic tissue after therapeutic intervention. Mean healing time was 13.2 weeks. Considering a 20-week follow-up, 74.1% of ulcers healed before this period. In addition, regarding pain felt by people with chronic wounds, all of them reported improvement, even though its level was not assessed by this study. “

The applications, citing Eastern European studies has been reviewed by Asavova<sup>9</sup>. The applications can be summarised as follows, together with indication of the number of the successful studies:

Ulcers: 5; Burns: 2; Healing of damages due to cancer radiation treatments:2; badly healing wounds: 1

In humans it has been used for treatment of surgical diseases<sup>78</sup>, wounds<sup>62</sup> and burns<sup>73, 156</sup>. In Cuba a better success was achieved by mixing honey, propolis and thyme oil

In the Russian centre for the treatment of burns 15 % propolis in animal fat or plant oils was used. The propolis ointment had an anaesthetic, bactericidal and wound regeneration effect, improving also blood and lymphatic<sup>156</sup>. More recently the Russian preparation Propolis Geliant, based on a propolis containing mixture with sunflower oil and heavy fractions of a dark natural wax is successfully used for the treatment of burns, wounds, skin diseases and in cosmetics<sup>39</sup>

Hartiwich et al. (2000) tested propolis treatments on patients operated for goitre, patients with wounds and ulcerations difficult to heal and patients with non-specific rectal inflammation. They also tested the effectiveness of propolis as supplementary means in eradicating treatment of *Helicobacter pylori*. It was found that the drug was tolerated very well, practically had no side-effects and was highly effective<sup>78</sup>

In another study, the effect of Brazilian propolis skin cream was compared with that of silver sulfadiazene (SSD) in the treatment of minor burns (superficial second degree) in the ambulatory care setting (less than 20% total body surface area burned). The study was conducted at a burn clinic in Brazil. Patients were admitted to the study only if their initial presentation for burn care was within 48 hours postinjury and if bilateral wounds of similar depth and quality were present. Patients had propolis skin cream applied to one wound and SSD applied to the other selected wound on initial presentation and underwent debridement and dressings change the following morning. Patients subsequently returned to the clinic every 3 days to have the wounds checked and dressings changed. At these check-ups, wounds were cultured for microbial growth and photographed to document inflammation and cicatrization. Patients were instructed not to disturb their wounds or change their dressings at home, thus propolis skin cream and SSD were applied to the wounds only at the specified 3-day intervals. The results do not show any significant difference in microbial colonization between wounds treated with SSD and propolis skin cream, however, wounds treated with propolis skin cream consistently showed less inflammation and more rapid cicatrization than those treated with SSD. It is concluded that propolis skin cream appears to have a beneficial effects on the healing of partial thickness burn wounds. More frequent application of propolis should enhance the antimicrobial and wound healing effects of propolis<sup>73</sup>.

**Application forms: Propolis ointments or creams, 10-20 % propolis water tinctures.**

## **Skin diseases**

Against epidermophytosis, skin tuberculosis alopecia; psoriasis; different microbial and chronic eczemas, cutaneous conditions of cold regions, pyoderma; Trichophyton skin inflammation<sup>9</sup>

**Application forms: 10-50 % propolis ointments or creams, 10-20 % propolis water tinctures**

## **Eye diseases**

Several successful clinical studies on the treatment of a variety of eye diseases are reported: keratitis, conjunctivitis and blepharitis<sup>9</sup>. 0.3 - 1 % aqueous propolis solutions have been applied.

Tichonov et al. developed special propolis preparations, based on specific propolis fractions, especially adapted for eye applications<sup>218</sup>.

## **Gynecology and urology**

The applications of propolis in gynecology and urology are based on the antibacterial and anti-inflammatory effects of propolis. These applications have been reviewed by Asavova<sup>9</sup>. Most successful is the treatment of the inflammation of the vagina and of the female genital area, where 8 successful studies were cited. For this purpose direct application of 20-30 % EEP and EEP-tampons were used. Two studies with successful treatments of vagina erosions were cited, alone or in combination with cortisone creams, with application of 15% propolis in fatty cream or intake of EEP.

## **Other external applications**

Propolis ointments have been successfully used against cold sores, *Herpes simplex* skin lesions and Herpes zoster lesions<sup>69, 82</sup> and also against genital herpes<sup>69, 82, 225</sup>.

Egyptian propolis was successfully used against different types of warts<sup>230</sup>

According to Potschinkova propolis-beeswax warming plasters can be used for the treatment of arthritis and arthrosis and against sprains, physical injuries, inflammations of muscles, nerves and filaments<sup>174</sup>. Propolis ointments are also used for these conditions.

**Attention when applying propolis externally: test for propolis contact allergy before application**

## VETERINARY MEDICINE AND AGRICULTURE

The application of propolis in veterinary medicine is based on its antimicrobial properties. It is reviewed in the monographs of Zakoff<sup>222</sup> and Teterev (1998)<sup>217</sup>

### Uses of propolis in veterinary medicine

Mastitis: application of propolis linement	54, 99, 125, 130, 217
Gynecological diseases: application of propolis candles	217
Feeding of weak pigs, prophylactics of gastroenterological and respiration diseases of pigs; feeding with 0.5 % propolis in milk	217
Improves weight gain and reduced diarrhoea in mild-fed calves with 5 ml of 20% ethanol extract	74
Prophylactics of calf diarrhoea: at to feeding 0.5 ml/kg of 10 % ethanol extract	217
Prophylactics against paratyphoid fever of ducks: feeding with 50 % propolis aqueous extract	217
Wound healing: application of 5% propolis in fish oil or fat	217
As a local anaesthetic in surgery: 1 to 10 % PEP	222
Against foot-and-mouth disease' induced damages on the utter of cows and pigs	222
Against enzootic pneumonia of pigs	222
Stimulant for the growth of underdeveloped lambs, pigs and calves	222

Teterev describes several preparations for veterinarian use: Biogel 5: containing 0.5 % propolis and 2 % carboxymethylcellulose for intake against gastroenterology diseases, for prophylaxis; Biogel 10, similar to biogel 5 but contains 1 % propolis.

### Agriculture

This use has been reviewed by Teterev<sup>217</sup>. Intake of propolis increases of weight gain, development rate and productivity of different animals. 1 to 10 % propolis in milk is used, the intake bein about 10 ml/kg. Following uses have been described.

- Weight gain, increased rate of development of animals and productivity
- Improvement of meat quality
- Increased rates of egg laying of hens

Propolis has been also used:

- ❖ to control the white rot disease of onions<sup>60</sup>
- ❖ against potato viruses<sup>59</sup>
- ❖ to inhibit the growth of *A. ochraceus* NRRL 3174 as well as biosynthesis of ochratoxin in Ras cheese ripening<sup>135</sup>
- ❖ as a natural antioxidant for conservation of plant oils and butter<sup>152, 153</sup> and meat<sup>75, 76</sup>
- ❖ against soy-bean and sunflower wild diseases<sup>76, 183</sup>
- ❖ inhibitory effect on germination and cell division in the root tips of wheat seedlings<sup>206</sup>

## FORMULATION AND APPLICATION FORMS

The application forms shown in this section are adapted after Ludyanski<sup>115</sup> Pochinkova<sup>174</sup>, Tichonov et al.<sup>218</sup> and in the online publication of [Krell](#)<sup>108</sup>, where more recipes can be found.

Prof. Tichonov and his team of the Ukranian Kharkov pharmacy faculty, has produced a detailed propolis monograph describing in detail different propolis preparations (poplar propolis) He compared the extraction of phenolic substances in 40, 70 and 95 % ethanol for 24 to 144 hours extraction time (maceration). Best extraction of the phenolics was achieved by 70 % and 95 % ethanol after 144 hours. About 90-95 % of the maximal extraction was achieved already after 72 hours. He also compared also the dependence of the extraction efficacy on the size of the propolis particles, best extraction was found with 0.5 - 1 mm particles. Tichonov developed a fractional-differential extraction method with better efficacy than the traditional maceration method. The extracted propolis is called Phenolic Hydrophobic Preparation (PHP). The aim was to produce a water soluble PHP containing a maximal concentration of the phenolic active ingredients, using detergents. For that purpose he uses Polysobate 20, 40, 60 and 80 (Tween 20) a polysorbate surfactants whose stability and non-toxicity

allows it to be used as detergents and emulsifiers in a number of domestic, scientific and pharmacological applications. The oral toxicity dose for the Tween substances is 25 g/kg. A maximal concentration of the phenolic fraction was achieved by mixing 1 part of PHP, 0.3 p Tween 80 and 0.5 p water, a concentration of 55.5 % PHP. Tichonov tested also solubilisation with different non toxic, synthetic non-ionic surfactants. He chose ethylene oxide / propylene oxide copolymers type surfactants with a MW of 5500. Tichonov determined the bioavailability and the toxicity of water soluble PHP. Based on his studies different propolis preparations are marketed in the Ukraine<sup>218</sup>.

A topical formulation of Brazilian propolis was developed, containing Polowax as a stabilizer against UV damage<sup>121</sup>.

## Raw propolis

Unprocessed, pure propolis can be frozen and broken down to pieces or ground to fine powder. Large pieces of propolis can be chewed, but it should be consumed in small quantities. Powder can be made into capsules or mixed with food or drinks. A special form of raw propolis, the so called water soluble whole propolis has been developed by Glenn Perry, [www.glennperry.com](http://www.glennperry.com)

## Whole dry water soluble propolis

A patent described by Sosnowski<sup>207</sup>, based on the extraction of poplar propolis

*“The following examples are set forth in order to fully describe the method for extracting and purifying propolis as well as the resulting dry propolis powder and its uses. About 500 grams of clean raw propolis was placed in an amber glass container and covered with about 1 liter of absolute ethanol. This mixture was allowed to sit for ten days at room temperature with periodic agitation several times each day. At the end of ten days, the mixture was filtered through Whatman No. 1 filter paper. The resulting propolis-containing filtrate was then incubated at about 70 degrees C until a dry propolis powder was obtained”.*

Another method patented by Hajime (1999) uses extraction of Brazilian propolis under conditions of pH adjustment, the method is available [online](#)

Glenn Perry [www.wholepropolis.com](http://www.wholepropolis.com) developed a method for the preparation of whole water soluble propolis as a water emulsion.

## Ethanol tinctures

### Practical considerations

- ❖ *For human use only non-toxic solvents should be used, ethanol of Pharmacopeia quality is the best choice.*
- ❖ *Propolis should be pure, remove coarse debris and excessive wax.*
- ❖ *Place propolis in freezer and break it in small pieces or mill it to powder for a better solubility*
- ❖ *60-80 % aqueous ethanol solutions have a higher biological activity than tinctures, prepared with more or less water<sup>159, 160</sup>*
- ❖ *Prepare a 70 % (v/v) aqueous ethanol by adding 700 ml ethanol to 300 ml of water*
- ❖ *Calculate necessary quantities of propolis and aqueous ethanol. Solutions are expressed in weight per weight. 1 L of ethanol weighs ca. 800 g, 1 L of 70 % eth., ca. 860 g*
- ❖ *5-30 % propolis solutions are used, do not make more than 30 % solutions in order to prevent precipitation of active compounds.*
- ❖ *Ethanol tincture intake only after a strong dilution with water (10-30 drops in a glass of water)*

### Propolis ethanol tincture

- ❖ *Add 100 g propolis to 400 g 70 % ethanol (for 20 % tincture)*
- ❖ *Store vessel in the dark for at least two days, better one or two weeks, shaking occasionally (the longer the extraction time, the greater the concentration of active ingredients, but more than 2 weeks does not bring more benefit)*
- ❖ *Filter through a paper filter (coffee filter will do) and store tincture closed in a clean dark vessel. If vessel is not brown or reddish, store in the dark, or pack vessel in aluminium foil.*

## Different uses of propolis in cosmetics after [Krell](#)<sup>108</sup>

Function	Application
Anti-bacterial agent	Deodorants and antiperspirants
Anti-dandruff and sebum equalizing agent	Shampoos and hair lotions
Anti-microbial and healing agent	Anti-acnes and after-shave products
Purifying agent	Cleansing creams and lotions
Preservative	In all of the above

### Propolis for skin care

Propolis used in skin care is based on its anti-allergy, anti-inflammation, anti-androgen, anti-lipase, an antimicrobial and a promotive action on collagen synthesis<sup>216</sup>. Thus, the dermatological and cosmetic uses for propolis and its extracts are very common<sup>113</sup>. The skin lesion applications of propolis have been reviewed by Barbosa et<sup>25</sup>

***Propolis can be used in skin and mouth cosmetics for mouth prophylactics and for the preventions of different stomatological pathologic conditions: stomatitis, paradontosis, gingivitis and caries. While use of Baccharis propolis is without problems, people using poplar propolis allergy should make an allergy test.***

## ALLERGY AND TOXIC EFFECTS

Most allergy studies are conducted with poplar propolis. There are no reporteds on allergy cases of other propolis types.

### Contact dermatitis

Poplar propolis can cause contact dermatitis. The responsible contact allergen are 3-methyl-2-butenyl caffeate and phenylethyl caffeate<sup>226</sup>

In a 2010 contact dermatitis test in the UK with 2828 normal human subjects 1.9 % were found to be sensitive to propolis<sup>176</sup>. In a questionnaire filled out by 1051 German beekeepers 3.6 % declared skin sensitivity to propolis. Thus it seems that people that regular contact with poplar propolis seems to have a skin allergising effect. In another study 4.1 % of 605 dermatitis allergic patients were allergic to propolis<sup>117</sup>.

Walgrave reviewed different contact dermatitis studies and concludes that 1.2 to 6.6 % of the patients undergoing patch testing are sensitive to propolis<sup>226</sup>.

Individual cases of people allergic to ingested propolis (mouthwash, toothpaste) have been described<sup>31, 64, 80</sup>.

Special hypoallergic propolis preparations have been developed for skin and wound applications<sup>83, 137</sup>

### Allergy after ingestion

Propolis allergy upon ingestion seems to be less frequent than contact allergy, due probably to its anti-allergenic and anti-inflammatory properties (see table 4). No data on the allergy frequency of the population is available. Reports on individual cases of people allergic to propolis ingestion have been published<sup>80, 85</sup>.

### Toxicology

Burdock reviews many animal toxicological studies in animals. He concludes that an intake until 4000 mg/kg per day there are no measurable effects and establishes a No Effect Level (NOEL) at 1400 mg/kg per day<sup>7</sup>.

Generally a safety margin of 100 is assumed for drug and food additives. This means that a maximum of 14 mg/kg per or 980 mg per day for a human of 70 kg can be the daily acceptable intake.

***It is necessary to supply information on the labels of propolis skin and cosmetic products about possible allergy reactions in risk individuals. Ingestion of propolis products is without problems.***

## HEALTH CLAIMS FOR PROPOLIS

According to the EU Regulation 1924/2006<sup>58</sup> different health claims can be made. The claims are classified using the Passclaim project classification of the International Life Science Institute (ILSI), wherever possible. In the Passclaim project the claims are classified into the following subject areas:

1. Diet-related cardiovascular disease
2. Bone health and osteoporosis
3. Physical performance and fitness
4. Body weight regulation, insulin sensitivity and diabetes risk
5. Diet-related cancer
6. Mental state and performance
7. Gut health, digestion and immunity

According to the evidence presented in this review following health claims can be made:

### 1. Diet-related cancer

*Intake of propolis can reduce the risk for the immergence of cancer*

### 2. Gut health, digestion and immunity

*Intake of propolis can imporove gut health, digestion and immunity*

## APPLICATION FORMS, INTAKE, AND DOSAGE

### Application forms

#### Tinctures

The most widely used form as 10 or 20 % tinctures in 70 to 100 % ethanol. The percentage of the propolis tinctures is calculated according to the amount of propolis used. However the actual concentration of the propolis components is only half of that as the alcohol soluble resin is about 50 % of the total propolis.

An intake of 3 times 20 drops of 20 % tincture a day corresponds to about 1 g tincture (from a standard 30 ml eye drop bottle) or about 200 mg of propolis per day, far from the maximum of 1400 mg per day. Children: half dose.

#### Propolis in honey

In many countries propolis is mixed to honey at about 1 g/100 g ratio. 10 g of honey (one full tea spoon) corresponds to about 100 mg of propolis. An intake of 3 spoons per day is often recommended, corresponding to a total of 300 mg propolis. Children: half dose

#### Tablets

Tablet contain generally about 50 mg of propolis, 3 to 6 pills per day are recommended, in total 300 mg of propolis, children: half dose.

## LEGAL STATUS OF PROPOLIS: FOOD SUPPLEMENT OR MEDICINE

In most countries of the world the propolis use is not regulated. In some countries, e.g. Austria, France, Spain, Japan, Taiwan, Korea, USA and Brasil propolis is considered as food supplement, together as the bee products bee pollen and royal jelly. In others like Switzerland and Germany it is considered a medicine.

Due to its natural variation and varying properties propolis its application in medicine is problematic. It should be rather considered a food supplement with functional properties.



*The health enhancing properties of propolis have much in common with the original function of propolis as a “defendant of the hive”. It is used to defend human health against microbes and to inhance human immunity against microbial intruders and disease.*

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