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THE HISTORICAL USES OF PROPOLIS IN FOLK MEDICINE, WITH ITS BIOLOGICAL ACITIVITES AND CHEMICAL COMPOSITION

Halk ilaçlarında Propolisin Tarihi Kullanımı ile Onun Biyolojik Aktivitesi ve Kimyasal Kompozisyonu

(Genişletilmiş Türkçe Özet Makalenin Sonunda Verilmiştir)

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ABSTRACT: Propolis is alike of gum material produced by honey bees in the construction and maintenance of their hives. Here the antifungal, antibacterial, antiviral, insecticidal and antioxidant activities of propolis, among other attributes of propolis and the chemical composition are reviewed**.** In recent years the biological activity research on propolis has become increasingly very attractive to many scientists in various fields of research. The comparative biological studies of propolis of different origin and the chemical composition analyses are becoming atractive. Similar types of studies are extremely valuable with the help of information about propolis standardization and practical applications in scientific fields.

Keywords: Propolis, *Apis mellifera*, bioactive compound, beeswax, plant.

Anahtar kelimeler: Propolis**,** *Apis mellifera*, biyoaktif bileşim, balmumu, bitki.

INTRODUCTION

Propolis, collected by *Apis mellifera* bees from various plant sources and mixed with secreted beeswax, is a multifunctional material used by bees in the construction, maintenance, and protection of their hives **(**Burdock, 1998; Ghisalberti, 1979). Bees have been observed scraping the protective resins of flower and leaf buds with their mandibles and then carrying them to the hive like pollens on their hind legs. These resins are used by worker bees to line the inside of nest cavities and all brood combs, repair combs, seal small cracks in the hive, reduce the size of hive entrances seal off inside the hive any dead animals which are large to be carried out and perhaps most important of all, to mix small quantities of propolis with wax to seal brood cells (Anon, 1965; Asis, 1989; Ask-Upmark, 1967; Andrich et al., 1987).

The literal meaning of propolis is derived from the Greek *pro-,* for or in defense, and *polis*-, the city, that is, defense of the city (or the hive) (Ghisalberti 1979). Propolis is a strongly adhesive, resinous substance collected, transformed and used by bees to seal holes in their honeycombs, smooth out the internal walls and protect the entrance against dangers from the outside. Honeybees (*Apis mellifera* L.) collect the resin from the cracks in the bark of trees and leaf buds. Resine is masticated and then salivary enzymes added and the partially digested material is mixed with beeswax and used in the hive (Ghisalberti, 1979; Marcucci, 1995). Although propolis may contain some pollen, it is not pollen. Although definitive studies of the metabolism of propolis do meet in the literature, the metabolism of many components of propolis is well known. The biologically most active component of propolis, the flavonoids, is known to be metabolized with no residues of flavonoids accumulating in the body (Havsteen, 1983). Acute toxicity tests of raw, unprocessed propolis would not be expected and because the method for propolis extraction remains unstandardized, variability in reported toxicity would be expected. Nonetheless, a useable body of data exists. For example, Arvouet-Grand et al. (1993) reported the oral LD_{50} of propolis extract in the mouse to be greater than 7340 mg/kg, while reported an LD_{50} of 2050 mg/kg and an LD_{100} of

2750 mg/kg. As the most important chemical weapon of bees against pathogenic microorganisms, propolis has been used as a medicine by human being since ages ago for treatment of wounds, burns, sore throats and stomach ulcers. For this reason, propolis has become the subject of intense pharmacological and chemical studies for the last 30 years. Numerous studies carried out with combined efforts of phytochemists and pharmacologists, led on recent years to the idea that different propolis samples could be completely different in their chemistry and biological activity (Bankova, 2005). The propolis is used traditionally in folk medicine mainly because it's antibacterial effect. Other properties, as antifungal, antiviral, anti-inflammatory and immuno-stimulating have also been described to this resin (Beyer and Melzig, 2005).

In this article, the available information concerning the antifungal, antiviral, insecticidal, antioxidant biological activity of propolis, among other attributes of propolis and the chemical composition of propolis are summarized**.**

Uses of Propolis

Bees have been about in existence for -125 million years and bees evolutionary success has allowed them to become perennial species that can exploit virtually all habitats on Earth (Bankova, 2005). East European countries have a lot studies. Western European and North American medical research has ignored this source of milder and useful material (Budavari, 1989; Chernyak, 1973; Ghisalberti 1979). The wound healing properties of propolis were known to the Egyptians, Greeks and Romans and in ancient times in Europe and North Africa. In 12th century, medicinal preparations with propolis are described for treating mouth and throat infections, as well as caries (Apimondia, 1975b; Apimondia, 1978; Apimondia, 1975a). Prevalent medicinal uses of propolis include treatment of the cardiovascular system and blood system (anemia), respiratory apparatus for various infections. (Apimondia, 1975b, Apimondia, 1978; Apimondia, 1975a). Propolis has been taken by mouth for bacterial infections such as tuberculosis; fungal infections such as oral candidiasis (thrush); parasitic infections such as malaria; and viral infections such as colds. Flavonoids in propolis have been shown to slow down or stop the division of bacterial cells in studies and also propolis is believed to have similar inhibitory effects on viral and fungal cells. (http://natural-propolis.blogspot.com 2012).

A chemical in propolis that it contains--caffeic acid phenethyl ester (CAPE) -- may interfere with the formation of substances that promote inflammation in the body and also propolis has been used in folk medicine to treat skin wounds. In a study of individuals with second-degree burns, cream with propolis and a prescription burn cream produced about equal results in preventing infection, but the cream with propolis promoted earlier healing and seemed to decrease inflammation more than the prescription (http://www.chembalpharma.com 2012). Ethanolic extracts of propolis have been shown to inhibit the activity of a mixture of crude glucosyltransferase (Gtf) enzymes in solution and also these enzymes are important for the formation of pathogenic dental plaque (Koo et al. 2000; Abd El Hady and Hegazi 2002; Akao et al. 2003; Ansorge et al. 2003; Borelli et al. 2002; Bretz 1998). In general, propolis is fairly stable, but suitable storage is important. Propolis and its extracts should be stored in airproof covers in the dark, preferably at less than 10ºC-12ºC and away from extreme and direct heat. Alike, very old propolis from the hive should not be mixed with fresher propolis. (Apimondia, 1975b; Apimondia, 1978; Apimondia, 1975a). After attach to other products, testing for propolis becomes even more complicated and overall product quality becomes important. Since there is much products in which propolis can be included, the standards for each type of product need to be considered (Budavari, 1989; Chernyak, 1973; Ghisalberti, 1979). One easy way to identify a different kind of quality, especially poor quality as a defect, is the homogeneity of products containing propolis extracts. Hand-mixed emulsions only stable for shorter periods. Thus special care needs to be taken to ensure the compatibility of the extraction method. Better mixing techniques and suitable emulsifiers, longer time, higher speed, different mixing sequences and warmer temperatures would have to be determined by testing (Budavari 1989; Chernyak 1973; Ghisalberti 1979).

Side Effects

Propolis may cause asthma attacks suffers from asthma. The exceptional side effects known to be associated with propolis are irritations of the skin or mucous membranes where it is applied (Burdock, 1998).

Physical characteristics of propolis

The colour of propolis ranges from yellow to dark brown depending on the origin of the resins. Rarely,

even transparent propolis has been reported. At temperatures of 25ºC to 45ºC propolis is a soft, pliable and sticky substance and propolis will become liquid at 60°C to 70ºC, but for some samples the melting point may be as high as 100°C (Andrich et al., 1987).

The chemical and biological composition of propolis

Bees use materials resulting from a variety of botanical processes in different parts of plants for propolis (Bankova et al., 1987; Bankova et al., 1991; Bankova et al., 1998).These are materials actively secreted by plants as well as materials exuded from wounds in plants (Bankova, 2005).

Thereabouts, raw propolis is composed of 50% resin (polyphenolic fraction), 30% wax, 10% essential oils, 5% pollen and 5% various organic and inorganic compounds (Burdock 1998; Bankova et al., 2000). More than 200 compounds have been identified and so chemical composition of propolis is very complex (Burdock, 1998; Langner and Schilcher, 1999). Its biological activity depends on compounds from the polyphenolic fraction, flavonoids, aromatic acids, phenolic acid esters, lignans, triterpenes, *etc.* (Burdock 1998; Bankova et al. 1998). These groups of compounds are reported to have bactericidal (Pepeljnjak et al., 1982; Mirzoeva et al., 1997) fungicidal, antiviral (Kujumgiev et al., 1999), antiprotozoal (Bankova et al. 1998), antioxidant (Russo et al., 2002), anti-inflammatory (Borelli et al. 2002) and immunomodulatory (Orsolic and Basic, 2003) effects.

Scientific evidence

One of the most known and extensively tested properties of propolis is its *antibacterial activity* and so scientific tests have been conducted with a variety of bacteria. Many scientific articles related to the pharmacological properties of propolis mention its antihepatotoxic, antitumour, antioxidative, antimicrobial, and anti- inflammatory properties (Banskota et al., 2001; Król et al., 1990). Many of the studies tests have shown positive control of the organisms by various extracts and concentrations of propolis (Bankova et al., 1989).

Antifungal activity of propolis

Among the substances in propolis, the flavonoids are occupies a wide space, which are identified as being responsible for its anti-inflammatory, antimicrobial, and in particular its antifungal actions (Sommez et al., 2005; Cushnie and Lamb 2005; Oliveira et al., 2006). The activity of European propolis against a broad range of some species of fungi has been associated to the presence of flavonoids and derivatives of caffeic acid (Kujumgiev et al., 1999; Bosio et al., 2000; Hegazi et al., 2000; Sawaya et al., 2002; Aliyazıcıoğlu et al., 2010). The results of Silici et al., (2003) showed that *Candida albicans*, *C.glabrata*, *Trichosporon* spp., and *Rhodotorula* sp. were susceptible to low concentrations of propolis, the latter showing a higher susceptibility and so relative to the other propolis tested, the propolis sample collected by *Apis mellifera caucasica* possessed the highest antifungal activity against all of the superficial mycoses. In addition, the results of Yavuz and Ertürk (2011) showed that *Candida albicans*, *Saccharomyces ceravisiae* and *Aspergillus niger* weren't susceptible to low concentrations of propolis and Propolis from Ordu, Turkey that the highest antifungal activity towards to *Aspergillus niger.*

Antimicrobial activity of propolis

The antimicrobial activity has been discovered on gram-positive and gram-negative bacterial species, including anaerobic bacteria of human oral cavity, mycobacteria, yeasts, parasites and viruses (Krol et al., 1993; Amoros et al., 1994; Harish et al., 1997; Bosio et al., 2000; Drago et al., 2000; Sforcin et al., 2000; Banskota et al., 2001; Huleihel and Isanu 2002; Koo et al., 2002; Santos et al., 2002; Santos et al., 2003; Santos et al., 2005; Stepanovic et al., 2003; Salomao et al., 2004; Orsi et al., 2005; Freitas et al., 2006; Aliyazıcıoğlu et al., 2010). The function of antimicrobial activity of propolis is complex.it could be attributed to the collective activity between phenolic and other compounds (Krol et al., 1993) primarily the galangin, pinobanksin flavonoids and pinocembrin (Burdock, 1998; Castaldo and Capasso, 2002) which disconnect the energy transducing cytoplasmic membrane and inhibit bacterial motility (Mirzoeva et al., 1997). The antibacterial activity of propolis has been correlated to the content of galangin, which has been indicated to be mainly responsible for antibactericidal activity (Pepeljnjak and Kosalec, 2004). *In vitro* interaction between propolis and antimicrobial drugs has been investigated (Krol et al., 1993; Scheller et al.,1999; Stepanovic et al., 2003) and combination of propolis with certain antibiotics and antifungals seem to be of potential medical interest (Stepanovic et al., 2003). Antibacterial and antiviral activity of Actichelated® propolis greater than hydroalcoholic

extract has been proved, it also able to step in bacterial adhesion to human oral cells (Drago et al., 2007). Propolis have shown especially good antimicrobial activity against many strains of bacteria have shown, above all *Streptococcus pneumoniae, Haemophilus influenzae* and *Moraxella catarrhalis,* but not against *Enterobacteriacae* (Dzık et al., 2003). According to Yavuz and Ertürk (2011), propolis extracts collected from Van, Erzurum, Gümüşhane, Ordu, Rize and Muğla cities of Turkey showed highest antimicrobial activity against *Bacillus cereus, Listeria monocytogenes, Staphylococcus aureus, Escherichia coli, Pseudomonas auroginosa, Salmonella typhimurium, Shigella sonnei, Yersenia enterocolitica* but not against *Clostridium perfingens, Klebsiella pneumonia* and in addition, propolis from Rize against *Bacillus cereus* and propolis from Erzurum against *Listeria monocytogenes* showed the highest antibacterial activity than other bacteria.

Antiviral activity of propolis

Used for medicinal purposes, propolis has been shown in more recent times to possess broad spectrum antimicrobial activity since ancient times, including activity against many of the opportunistic pathogens associated with the acquired immunodeficiency syndrome (AIDS) (Banskota et al., 2001; Burdock 1998). Studies of its antiviral properties have concentrated principally on herpes simplex virus (Amoros et al. 1994; Vynograd et al., 2000) and another study, influenza virus (Serkedjieva et al., 1992). Using a cell line (CEM cells) propolis potently inhibited HIV-1 expression (Harish et al. 1997). The antiviral effects of propolis have generally showed very good results. The inclusion of a propolis extract in mouthwash and toothpaste helps to treat oral infections and even heal surgical wounds. Another clinical study also showed that the extract was particularly effective in shortening the symptoms of influenza (Serkedjiev et al., 1992). Propolis extracts clearly have virucidal properties as well (Amoros et al., 1992) investigated the *in vitro* effect of propolis on different DNA and RNA viruses including herpes simplex type 1 , herpes simplex type 2, adenovirus type 2, vesicular stomatitis virus and poliovirus type 2. The inhibition of poliovirus propagation was clearly discovered through a plaque reduction test and a multistep virus replication assay with a selectivity index equal to 5. At the concentration of 30 *µ*g/ml, propolis reduced the titre of herpes viruses by 1000, whereas vesicular stomatitis virus and adenovirus were less sensitive. The effect of propolis on virus multiplication, propolis was also found to exert a virucidal action on the enveloped viruses HSV and VSV (Amoros et al. 1992).

Insecticidal activity of propolis

There is very limited literature on the acaricidal or insecticidal action of propolis. Considering that while plants produce compounds allure to bees, they need to protect other parts, generally the place where bees collect substances to make propolis, from herbivore attack. This defense is commonly made by repellents, deterrents or even by toxic chemical compounds (Harborne, 1988). Propolis contains substances of plant origin, and is reported to have medicinal, insecticidal, antimicrobial and phytotoxic properties. The different components of propolis are produced by plants in order to avoid infection of injured plant parts and help ward off and kill insects or mite pests (Ogren, 1990). Components of nectar, pollen and propolis may adversely affect the development of *V. destructor* in the hive of some bee populations(Amrin et al., 1996). Some authors suggested that some flavonoid components of propolis have insecticidal or at least insectstatic effects (König ve Dustmann 1988; Schkurat ve Poprawko 1980). Johnson, et al., (1994) researched the physical and chemical composition of North American samples of propolis and tested for bioactivity against larvae of the greater wax moth (*Galleria mellonella* L.), a common apiary pest (Johnson et al. 1994).

CONCLUSION

In this study; information on the antifungal, antiviral, insecticidal, antioxidant biological activity of propolis, among other attributes of propolis and the chemical composition of propolis were illustrated**.** This review could lead to increased production of propolis by farmers (the grower of honey and propolis) in rural communities and providing an additional source of income for them However this study could be used as a reference for scientists who study in the field.

REFERENCES

Abd El Hady FK., Hegazi AG.(2002). Egyptian propolis: Chemical composition, antiviral and antimicrobial activities of East Nile Delta propolis. Zeitschrift Fuer Naturforschung. Section C. Biosciences, 57: (3-4)386-394.

Agata Kabała – Dzık, Ewa Szaflarska – Stojko, Robert D. Wojtyczka , Artur Stojko Rafał

Stojko and Jerzy Pacha (2003). Comparatıve Studıes On The Antımıcrobıal Actıvıty Of Propolıs Balm And Sılver Sulphadıazıne Applıed To Burn Wounds In Pıgs, Bull. Vet. Inst. Pulawy, 47: 541-545.

Akao Y, Maruyama H, Matsumoto K, Ohguchi K, Nishizawa K, Sakamoto T, et al.(2003) Cell growth inhibitory effect of cinnamic acid derivatives from propolis on human tumor cell lines. Biological and Pharmaceutical Bulletin, 26: (7) 1057-1059.

Amoros, M., Lurton, E., Boustie, J., Girre, L., Sauvager, F. and Cormier, M. (1994). Comparison of the anti-herpes simplex virus activities of propolis and 3-methyl-but-2-enyl caffeate. J Nat Prod., 57:644–647.

Amoros, M., Sauvager, F., Girre, L. and Cormier, M. (1992). In vitro antiviral activity of propolis. Apidologie, 23: 231–240.

Amrin J., Noel B., Mallow H., Stasny T., Skidmore R. (1996). Results of research: using essential oils for honey bee mite control. http://www.wvu.edu/agexten /varroa.htm.

Ana Carla Pozzi Oliveira, Cristiane Suemi Shinobu, Renata Longhini, Selma Lucy Franco, Terezinha Inez Estivalet Svidzinski (2006). Antifungal activity of propolis extract against yeasts isolated from onychomycosis lesions. Memórias do Instituto Oswaldo Cruz,101(5): 493-7.

Andrich, G., Fiorentini, R. and Consiglieri, A. (1987). [Characteristics of some samples of propolis from the Ligurian Coast] Caratteristiche di alcuni tipi di propoli della Riviera Ligure. Citta delle Api, (28): 30-31, 34, 35, 37, 38.

Anon (1965). Productions du docteur Anon. French Patent No.1,396,582. In: Chem. Abstr.63:6782g(1965).

Ansorge S, Reinhold D, Lendeckel U.(2003). Propolis and some of its constituents down-regulate DNA synthesis and inflammatory cytokine production but induce TGF-beta1 production of human immune cells. Zeitschrift Fuer Naturforschung. Section C. Biosciences 58: (7-8) 580-589.

Apimondia, (1975a). A valuable product of bee-keeping: propolis. Researches and views on its composition, properties and therapeutic value. Apimondia Publishing House, Bucharest. Rumania 167.

Apimondia, (1975b).The hive products: food health and beauty. Proc. of Intern. Symp. on Apitherapy. Apimondia Publishing House, Bucharest, Romania 154.

Apimondia, (1978). A remarkable hive product: propolis. Apimondia Publishing House, Bucharest 250.

Arvouet-Grand, A., Lejeune, B., Bastide, P., Pourrat, A., Legret, P. et al.(1993). Propolis extract. Part 6. Subacute toxicity and cutaneous primary irritation index. Journal de Pharmacie de Belgique 48: 165–170.

Asis, M. 1989. [Propolis: the purple gold of honeybees.] Centro de Informaci6n y Documentaci6n Agropecuano, Havana, Cuba, 255 pp.

Ask-Upmark, E.(1967). Prostatitis and its treatment. Acta Med. Scand., 181: 355-357.

Bankova, M., Boroskova', Z., Dubaj, J. and Sze'chenyi, S.(1989).The immunomodulative effect of propolis preparations on guinea pigs with experimental ascaridosis. Helminthologia, 26(2): 163-172.

Bankova, V. and 4 others. (1991). A study on the origin of Bulgarian propolis. Apiacta 26: (1): 13-17.

Bankova, V. Dyalgerov, A., Popov, S. and Marekov, N.L. (1987). [A GC of /MS study the propolis phenolic constituents]. Z. f. Naturforschung , 42: 147-151.

Bankova, V. S.,Castro, S. L de,and Marcucci, M. C.(2000). Propolis: recent advances in chemistry and plant origin. Apidologie, 31: 3–15.

Bankova, V. S. Christov, R. S. and Tejera, A. D. (1998). Lignans and other, Constituents of propolis from the Canary Islands. Phytochem, 49: 1411–1415.

Bankova, V. (2005). Recent trends and important developments in propolis research Evid.-based complem. alternat. Med., 2: 29-32.

Banskota A.H., Tezuka Y., Kadota S.(2001). Recent progress in pharmacological research of propolis. Phytother. Res., 15:561–571.

Beyer, G. and Melzıg, M.F.(2005). Effects of propolis on hypoxanthine-xanthine oxidase-induced toxicity in cultivated human cells and on neutrophil elastase activity. Biol. Pharm. Bull., 28: 1183-1186.

Borelli, F., Maffia, P., Pinto, L., Ianaro, A., Russo, A., Capaso, F. and Ialenti, A. (2002). Phytochemical compounds involved in the anti-inflammatory effect of propolis extract. Fitoterapia, 73 (1): 53–63.

Bosio, K., Avanzini, C., D'Avolio, A., Ozino, O. and Savoia, D. (2000). In vitro activity of propolis

against *Streptococcus pyogenes*. Lett Appl Microbiol, 31: 174–177.

Bretz WA, Chiego DJ Jr, Marcucci MC, Cunha I, Custodio A, Schneider LG.(1998). Preliminary report on the effects of propolis on wound healing in the dental pulp. Zeitschrift Fuer Naturforschung. Section C. Biosciences 53(11-12): 1045-1048.

Budavari, S. (ed.). (1989). The Merck Index - Encyclopedia of Chemicals, Drugs and Biologicals. Rahway, NJ: Merck and Co., Inc., p. 1347] **PEER REVIEWED.

Burdock, G. A. (1998). Review of the biological properties and toxicity of propolis. Food Chem. Toxicol., 36: 341-363.

Castaldo, S. and Capasso, F.(2002). Propolis, an old remedy used in modern medicine. Fitoterapia, 73(1): 1–6.

Chernyak, N.F. (1973). On synergistic effect of propolis and some anti-bacterial drugs. Antibiotiki, 18:259-261.

Cushnie TPT, Lamb AJ. (2005). Antimicrobial activity of flavonoids. *Int J Antimicrobial Agents, 26*:343-356.

Drago, L., De Vecchi, E., Nicola, L. and Gismondo, M.R.(2007) In vitro antimicrobial activity of a novel propolis formulation (Actichelated propolis). Journal of Applied Microbiology, 10: 1365-2672.

Drago, L., Mombelli, B., De Vecchi, E., Fassina, M.C., Tocalli, L. and Gismondo, M.R.(2000). In vitro antimicrobial activity of propolis dry extract. J Chemother, 2: 390–395.

Freitas, S.F., Shinohara, L., Sforcin, J.M. and Guimaraes, S. (2006). In vitro effects of propolis on *Giardia duodenalis* trophozoites. Phytomedicine, 13: 170–175.

Ghisalberti, E.L.(1979). Propolis: a review. Bee World, 60 (2):59-84.

Harborne, J. B., (1988). In Introduction to Ecological Biochemistry. Academic Press, London, 3th. ed., pp. 356.

Harish, Z., Rubinstein, A., Golodner, M., Elmaliah, M. and Mizrachi, Y. (1997). Suppression of HIV-1 replication by propolis and its immunoregulatory effect. Drugs Expmtl Res., 89–96.

Havsteen, B. (1983). Flavonoids, a class of natural products of high pharmacological potency. Biochemical Pharmacology, 32: 1141–1148.

Hegazi, A.G., Abd-El-Hady, F.K. and Abd-Allah, F.A.(2000) Chemical composition and antimicrobial activity of European propolis. *Zeitschrift für Naturforschung* 55: 70–75.

http://natural-propolis.blogspot.com/2008/09/drug-digest-propolis.html .(2012).Welcome to Propolis: The Natural Antibiotic.

http://www.chembalpharma.com/product-id-65.html(2012) Propolis soft jel.

Huleihel, M. and Isanu, V. (2002). Anti-herpes simplex virus effect of an aqueous extract of propolis. IMAJ, 11(l): 923–927.

Johnson, K. S., Eischen, F. A. and Giannasi, D. E.(1994). Chemical composition of North American bee propolis and biological activity towards larvae of greater wax moth (*Lepidoptera: Pyralidae*). Journal of Chemical Ecology, 20: 1783-1791.

König B., Dustmann J.H. (1988).Baumharze, Bienen und antivirale Chemotherapie, Naturwiss. Rundsch, 2: 43–53.

Koo, H., Anne M. Vacca Smith, William H. Bowen, Pedro L. Rosalen , Jaime A. Cury , Yong K. Park (2000). Effects of *Apis mellifera* Propolis on the Activities of Streptococcal Glucosyltransferases in Solution and Adsorbed onto Saliva-Coated Hydroxyapatite. Caries Research, 34: 418-426.

Koo, H., Rosalen, P.L., Cury, J.A., Park, Y.K. and Bowen, W.H. (2002). Effects of compounds found in propolis on *Streptococcus mutans* growth and on glucosyltransferase activity. Antimicrob Agents Chemothe, r 46: 1302–1309.

Krol W., Czuba Z., Scheller S., Gabry J., Grabiec ś S. (1990). Antioxidant proper ty of ethanolic extract of propolis (EEP) as evaluated by inhibiting the chemiluminescence oxidation of luminol. Biochem. Int., 21: 593–597.

Krol, W., Scheller, S., Shani, J., Pietsz, G. and Czuba, Z. (1993). Synergistic effect of ethanolic extract of propolis and antibiotics on the growth of *Staphylococcus aureus*. Arzneimitt Forsch , 43: 607–609.

Kujumgiev, Tsvetkova, I. Serkedjieva, Yu. Bankova, V. Christov, R. and Popov, S. (1999). Antibacterial, antifungal and antiviral activity of propolis of different geographic origin, J. Ethnopharmacology, 64: 235–240.

Langner E. and Schilcher, H. (1999). Propolis–Qualität und Wirkungen von Propolis bzw. Propoliszuberetungen, Dtsch. Apoth. Ztg., 37: 51–63.

Marcucci, M. C. (1995). Propolis: chemical composition, biological properties and

therapeutic activity. *Apidologie,* 26 (2): 83-99 [En, fr\de, Bj] Biological Chemistry Laboratory, Chemical Institute of Universidade Estadual de Campinas, CP 6154, cep 13081-970, Campinas, SP, Brazil. 0BAuthor.

Mirzoeva, O. K.. Grishanin, R. N, and Calder, P. C. (1997). Antimicrobial action of propolis and some of its components: the effects on growth, membrane potential and motility of bacteria. Microbiol.Res., 52: 239–246.

Ogren W. (1990) What in the world is propolis used for? Am. Bee J. 130: 239-240.

Orsi, R.O., Sforcin, J.M., Funari, S.R. and Bankova, V. (2005). Effects of Brazilian and Bulgarian propolis on bactericidal activity of macrophages against *Salmonella Typhimurium*. Int Immunopharmacology, 5: 359–368.

Orsolic, N. and Basic, I. (2003). Immunomodulation by water-soluble derivative of propolis: a factor of antitumor reactivity. J. Ethnopharmacology, 84; 265–2.

Pepeljnjak, S. Jalsenjak and Maysinger, D. (1982). Growth inhibition of *Bacillus subtilis* and composition of various propolis extracts. Pharmazie, 37: 864–865.

Pepeljnjak, S. and Kosalec, I. (2004). Galangin expresses bactericidal activity against multiple-resistant bacteria: MRSA, *Enterococcus* spp. and *Pseudomonas aeruginosa*. FEMS Microbiol Lett, 240:111–116.

Rezzan Aliyazıcıoğlu, Hüseyin Sahin, Ömer Ertürk, Esra Ulusoy and Sevgi Kolaylı, Properties Of Composition and Bıologıcal Activity Of Propolis From Turkey, İnternational Journal Of Properties. DOI: 10.1080/10942912.2010.551312.

Russo, A., Longo, R. and Vanella, A.(2002). Antioxidant activity of propolis: role of caffeic acid phenethyl ester and galanging. Fitoterapia 73 (1): 21-29.

Salomao, K., Dantas, A.P., Borba, C.M., Campos, L.C., Machado, D.G., Aquino Neto, F.R. and de Castro, S.L.(2004). Chemical composition and microbicidal activity of extracts from Brazilian and Bulgarian propolis. Lett Appl Microbiology, 38: 87–92.

Santos, F.A., Bastos, E.M., Maia, A.B., Uzeda, M., Carvalho, M.A., Farias, L.M. and Moreira, E.S. (2003). Brazilian propolis: physicochemical properties, plant origin and antibacterial activity on periodontopathogens. Phytother Res.,17: 285–289.

Santos, V.R., Pimenta, F.J., Aguiar, M.C., do Carmo, M.A., Naves, M.D. and Mesquita, R.A. (2005). Oral candidiasis treatment with Brazilian ethanol propolis extract. Phytother Res., 19: 652–654.

Sawaya, A.C.H.F., Palma, A.M., Caetano, F.M., Marcucci, M.C., Cunha, I.B.S., Araújo, C.E.P. and Shimizu, M.T. (2002). Comparative study of *in vitro* methods used to analyse the activity of propolis extracts with different compositions against species of *Candida*. *Letters in Applied Microbiology*. 35; 203–207.

Scheller, S., Dworniczak, S., Waldemar-Klimmek, K., Rajca, M., Tomczyk, A. and Shani, J. (1999). Synergism between ethanolic extract of propolis (EEP) and anti-tuberculosis drugs on growth of mycobacteria. Z Naturforsch [C], 54: 549–553.

Schkurat B.T., Poprawko C.A. (1980). Effect of propolis against *Varroa*. Pchelovodstvo, 1:19.

Serkedjieva, J., Manolova N and Bankova, V. (1992). Anti-influenza virus effect of some propolis constituents and their analogues (esters of substituted cinnamic acids). Journal of Natural Products, 55: 294–302.

Sforcin, J.M., Fernandes, A.Jr, Lopes, C.A., Bankova, V. and Funari, S.R. (2000). Seasonal effect on Brazilian propolis antibacterial activity. J Ethnopharmacology, 73: 243–249.

Silici,S., Kaftanoğlu, O. (2003). Antimicrobial Analysis of Propolis Samples From Different Regions In Turkey. Uludağ Arıcılık Dergisi, pp16-18.

Sönmez S, Kirilmaz L, Yucesoy M, Yücel B, Ylmaz B.(2005).The effect of bee propolis on oral pathogens and human gingival fibroblast. J Ethnopharmacology, 102: 371-376.

Stepanovic, S., Antic, N., Dakic, I. and Svabic-Vlahovic., M.(2003). In vitro antimicrobial activity of propolis and synergism between propolis and antimicrobial drugs. Microbiol Res., 158: 353–357.

Vynograd, N. Vynograd I. and. Sosnowski, Z. (2000). A comparative multi-centre study of the efficacy of propolis, acyclovir and placebo in the treatment of genital herpes (HSV), Phytomedicine, 7: 1–6.

Yavuz. C., Ertürk. Ö. (2011). Antimicrobial, Antioxidant Activities And The Determination Of Bioactive Components Of Propolis Samples Collected From Some Cities Of Turkey. Master tezis, Ordu.

GENIŞLETILMIŞ ÖZET

Propolis işçi balarıları tarafından üretilen reçinemsi bir madde olup arı kovanında yapım, koruma ve bakım gibi çok amaçlı kullanılan bir materyaldir. İnsanoğlu tarafından kullanılışı balın keşfi kadar uzun bir tarihe dayanır. Bu çalışmada, propolisin antifungal, antibakteriyal, antiviral, insektisidal ve antioksidan aktiviteleri ve kimyasal bileşimi özetlenmiştir. Son zamanlarda propolisle ilgili biyolojik aktivite çalışmaları birçok farklı alandaki bilim adamı için giderek daha da ilgi çekici hale gelmektedir. Farklı orijinlerden propolisin karşılaştırmalı biyolojik aktivite çalışmaları ve kimyasal bileşim analizleri giderek daha önemli hale gelmektedir. Bu tür çalışmalar, özellikle propolisin standardizasyonu ve bilimsel alanlardaki pratik uygulamaları açısından bilgi verici olmaları sebebiyle son derece değerlidir.

Reçineler veya polenlerin sebep olduğu alerjik reaksiyonlar nedeniyle propolis, bazı insanlarda astıma neden olabilir. Rengi sarıdan koyu kahveregine doğru değişir. 25-30°C arasında yumuşak ve çok yapışkan haldedir, 60-70°C' ta sıvıdır, fakat bazı örneklerin erime noktası 100°C'a kadar çıkabilir.

Farklı propolis örnekleri farklı kimyasal bileşenlere sahiptir. Ham propolis genel olarak %50 reçine, %30 balmumu, %10 esansiyel yağlar, %5 polen ve çeşitli organik, inorganik içeriğe sahip olabilir. Biyolojik aktivitesi fenolik parçalar, flavonoidler, aromatik asitler, fenolik asit esterleri, triterpenler, lignin vb. maddelerden oluşur. Bu grupların bakteri, mantar, virüs ve protozoa öldürücü, aynı zamanda antioksidan, antiinflamatuar ve immünomodülatör etkisi olduğu bulunmuştur. Propolisin antihepatotoksik, antitümör, antioksidatif, antimikrobiyal ve antiinflamatuar özellikleri, virüsler ve diğer mikroorganizmalar üzerine etkileri ile ilgili pek çok yayın vardır. Pek çok test bu özelliklerle ilgili olarak olumlu sonuç vermiştir.

Propolisin antibakteriyel ve antifungal özelliği flavonoidler ve kafeik asit türevlerinin varlığı ile ilişkili bulunmuştur. Ayrıca flavonoidlerin anti-enflamatuar özelliği olduğu da tespit edilmiştir. Propolis özellikle *Streptococcus pneumoniae, Haemophilus influenzae* ve *Moraxella catarrhalis'*e karşı antimikrobiyal etki gösterirken Enterobacteriacae türlerine karşı etki göstermemektedir. Son zamanlarda immün yetmezlik sendromu (AIDS) ile ilişkili birçok fırsatçı patojenlere karşı etkinliği de dahil olmak üzere, geniş spektrumlu antimikrobiyal aktiviteye sahip olduğu gösterilmiştir. Gargara ve diş macunu özü içerdiği, ağız enfeksiyonlarını önlediği ve hatta cerrahi yaraların iyileşmesine yardımcı olduğu bulunmuştur. Grip semptomlarını azaltma özelliği olduğu ile ilgili çalışmalar da mevcuttur. Virüs çoğalması üzerindeki etkisi yanı sıra, zarflı virüsler HSV (*Herpes Simplex* (Uçuk) Virüsü) ve VSV (*Vesicular Stomatitis* Virus) üzerinde bir virüsid tesir oluşturduğu da bulunmuştur.

Akarlar ve böcekler üzerine etkileri ile ilgili kısıtlı çalışma vardır. Propolisin yaralı ağaç parçalarının enfeksiyonu önlemek, böcekler veya akarları kovmak ya da öldürmeye yardımcı olmak için bitkiler tarafından üretilen farklı bileşenleri vardır. Bazı yazarlar propolisteki bazı flavonoid bileşenlerinin insektisidal ya da en azından insetstatik (böcek larvalarının gelişme inhibisyonu) etkisi olabileceğini ileri sürmüşlerdir ve büyük bal mumu güvesine (*Galleria mellonella* L.) olan etkisini test etmişlerdir.

Bütün bu olumlu özelliklerine bakıldığında, propolis ile ilgili çalışmaların önü oldukça açık görünmektedir. Özellikle bir arı ürününün daha ekonomiye katkısını sağlamak ve arı üreticilerini propolis üretimi için teşvik amacıyla bu makalenin faydalı olacağını düşünmekteyiz.