

Propolis and its direct and indirect hypoglycemic effect

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ABSTRACT

Propolis means a gum that is gathered by bees from various plants. It is strongly adhesive resinous substance, collected, transformed, and used by bees to seal holes in their honeycombs. Bees use it to seal holes in their honeycombs, smooth out internal walls, as well as to cover carcasses of intruders who died inside the hive in order to avoid their decomposition. Propolis also protects the colony from diseases because of its antiseptic efficacy and antimicrobial properties. It also has been reported to possess various biological activities, namely anticancer, antioxidant, anti-inflammatory, antibacterial, antifungal, and hypolipidemic. The aim of this review is to evaluate the hypoglycemic effect of propolis since a little number of researches studied this effect when we compare with the huge number of papers that reported many other biological activities.

Key words: Anticancer, antioxidant, anti-inflammatory, antibiotic, antifungal and antihepatotoxic, bees, propolis

INTRODUCTION

Allah said the following as written in Quran about bees in *Surat Al-Nabl*: "And your Lord inspired the bee, saying: "Take you habitations in the mountains and in the trees and in that what they erect; Then eat of all fruits, and follow the ways of your Lord, made easy [for you]. There comes drinks from their bellies, of varying colour wherein is healing for mankind. Verily, in this is indeed a sign for people who think."^[1]

Propolis, one of the drinks (honey, propolis, wax, pollens, venom, and royal jelly) that comes from bees bellies that mention in *Surat Al-Nabl*, and word of honey in Quran, was mentioned in *Surat Muhammad*.

Propolis has attracted researchers' interest in the last decades because of its several biological and pharmacological properties.^[2] Besides, propolis-containing products have been intensely marketed by the pharmaceutical industry and health-food stores.^[3]

Propolis is a resinous hive product collected by honeybees from various plant sources. It has a long history of being used in folk medicine dating back to many centuries. It also has been reported to possess various biological activities, namely anticancer, antioxidant, anti-inflammatory, antibiotic, antifungal, and antihepatotoxic.^[4]

Propolis means a gum that is gathered by bees from various plants. It is strongly adhesive resinous substance, collected, transformed, and used by bees to seal holes in their honeycombs. Etymologically, the Greek word propolis means *pro*, for or in defense, and *polis*, the city, that is "defense of the hive." Bees use it to seal holes in their honeycombs, smooth out internal walls, as well as to cover carcasses of intruders who died inside the hive in order to avoid their decomposition. Propolis also protects the colony from diseases because of its antiseptic efficacy and antimicrobial properties.^[5]

All forms of diabetes are characterized by chronic hyperglycemia and the development of diabetes-specific microvascular pathology in the retina, renal glomerulus, and peripheral nerve. As a consequence of its microvascular pathology, diabetes is a leading cause of blindness, end-stage renal disease, and a variety of debilitating neuropathies. When islet b-cell function is impaired, insulin secretion is inadequate, leading to overproduction of glucose by the liver and under-utilization of glucose in peripheral tissue.^[6]

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CHEMICAL COMPOSITIONS OF PROPOLIS

The precise composition of raw propolis varies with the source. In general, it is composed of 50% resin and vegetable balsam, 30% wax, 10% essential and aromatic oils, 5% pollen, and 5% various other substances, including organic debris. The wax and organic debris are removed during processing, creating propolis tincture.^[7]

The chemical composition of propolis is quite complicated. More than 160 constituents have been identified in different propolis samples,^[8,9] while others reported that more than 300 compounds such as polyphenols, phenolic aldehydes, sesquiterpene quinines, coumarins, amino acids, steroids, and inorganic compounds have been identified in propolis samples.^[10]

Despite the great differences in the chemical composition of propolis from different geographic locations, all samples exhibited significant antibacterial and antifungal and most of them antiviral activity. This suggests that in different samples, different combinations of substances are essential for the biological activity of bee glue.^[11] Moreover, it was observed that antioxidant properties mapped quite well according to geographical origin.^[12]

HYPOGLYCEMIC EFFECTS

Under physiological conditions, a widespread antioxidant defense system protects the body against the adverse effects of free radical production.^[13] The antioxidant defense system represents a complex network with interactions, synergy, and specific tasks for a given antioxidant. The efficiency of this defense mechanism is altered in diabetes and, therefore, the ineffective scavenging of free radicals may play a crucial role in determining the tissue damage.^[14]

Propolis-ethanol extract has a beneficial effect on reduction of blood sugar levels in alloxan-induced diabetes rabbits.^[15] Moreover, propolis also showed antihyperglycemic effect in patients with Type 2 diabetes.^[16] Furthermore, many studies showed that propolis and/or one of its active components reduced blood sugar level in experimental diabetic animals and modulated the metabolism of blood lipids leading to decreased lipid peroxidation and scavenge the free radicals.^[15-19] This makes the propolis a promising agent in the management of diabetes mellitus and its complications because in diabetes mellitus, chronic hyperglycemia produces multiple biochemical sequelae, and diabetes-induced oxidative stress could play a role in the symptoms and progression of the disease.^[20]

Oxidative stress in cells and tissues results from the increased generation of reactive oxygen species and/or from decrease in antioxidant defense potential.^[21]

On the other hand, the protective effect of propolis against the toxicity of streptozotocin (STZ) in rats was evaluated. It was found that water extract of propolis may prevent b-cells destruction. The authors thought that the free radical scavenging activity, together with inhibitory activities on IL-1 β synthase and nitric oxide (NO) synthase could be the prime factors for the protective effect of water extract of propolis against STZ toxicity.^[22]

Water-soluble fraction of Brazilian propolis and its bioactive constituent showed a strong antihyperglycemic effect, through the inhibition of intestinal maltase activity, this effect was more beneficial in modulating postprandial blood glucose level rise upon dietary carbohydrate intake.^[23] Propolis could be an effective functional food to prevent the development of insulin resistance induced by fructose-drinking rats in animal models that received 15% fructose solution in drinking water for 8 weeks.^[24]

The antidiabetic, hypolipidemic, and antioxidant effects of ethanolic extract of propolis (EEP) in STZ-treated rats were investigated. After 5 weeks of STZ injection, it was observed that there were significant increases in serum glucose, triglycerides, total cholesterol, and low-density lipoprotein-cholesterol with a concomitant decrease in serum high-density lipoprotein-cholesterol as compared with the control normal group. In addition, a significant elevation in pancreatic lipid peroxides measured as malondialdehyde (MDA) and serum NO amounting with marked reduction in serum reduced glutathione (GSH), catalase (CAT), and pancreatic superoxide dismutase (SOD) were found. Meanwhile, oral daily treatment of animals with EEP ameliorated STZ-induced alterations in the animal body weight as well as in serum glucose, lipids, lipoproteins, NO, GSH, and CAT and pancreatic MDA and SOD. This can conclude that EEP offers a promising therapeutic value in prevention of diabetes and dyslipidemic profile.^[19]

More recently, it was reported that propolis supplementation in STZ-induced diabetes is associated with a significant decrease in the blood glucose. Moreover, the same study showed that treatment of diabetic rats with propolis with insulin caused a significant decrease in glucagon levels and improvement of insulin/glucagon ratio to reach near that of the control (negative) group.^[25]

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