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Bee Pollen – A Potential Therapeutic Agent

Arı Poleni – Potansiyel Bir Terapötik Ajan

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ABSTRACT

Honeybee products including bee pollen (BP) have been a topic of interest by medical professionals for a long time. Recently, many studies revealed many natural compounds in BP that has a huge potential to express many therapeutic activities. Although in vivo studies are too few, there is wide variability on BP compounds due to several factors such as geographic and climate conditions, and there is a lack of standardization for the studies; nutritious, anti-microbial, anti-mutagenic, antioxidant, anti-inflammatory, anti-atherosclerotic, hypolipidemic, hypoglycemic, fibrinolytic effects and inhibitor activity to platelet aggregation were observed. So, BP holds the potential of being a major therapeutic agent, and to be a topic of medical scientific research.

Keywords: Bee Pollen; Apitherapy; Biopharmaceuticals; Honey-bee products

ÖZ

Arı poleninin de aralarında buluduğu arı ürünleri uzun yıllardan beri sağlık camiasının ilgi alanlarından biri olmuştur. Son yıllardaki çalışmalarda, arı poleninin terapötik aktivite potensiyeli taşıyan çok sayıda içerik barındırdığı gösterilmiştir. Her ne kadar in vivo çalışmalar sınırlı sayıda olsa da, coğrafi ve iklim koşullarına gore polen içeriğinde ciddi farklılıklar gözlense de ve yapılan çalışmalarda standardizasyon sorunu olsa da; arı poleninin, besleyici, anti-mikrobiyal, anti-mutajenik, antioksidan, anti-inflamatuvar, anti-aterosklerotik, hipolipidemik, hipoglisemik, fibrinolitik ve platelet aggregasyonunu inhibe edici etkileri gözlenmiştir. Bu kapsamda, arı poleninin ciddi bir terapötik ajan olabilme potansiyeli taşıyan ve tıbbi bilimsel çalışmalara aday bir doğal ürün olduğu değerlendirilmektedir.

Anahtar Kelimeler: Arı poleni; Apiterapi; Biyofarmasötikler; Arı ürünleri

Bee Pollen – A Potential Therapeutic Agent

Bee pollen (BP), also called "the life-giving dust," is a natural product formed by flower pollen and secretions of bees. The ancient Egyptian, Greek and Chinese medical records mention the use of pollen and its medicinal uses[1]. BP consists of carbohydrates, fibers, proteins and lipids. It also contains flavonoids, vitamins, carotenoids and phenolic contents. All the essential amino acids necessary for human body, including proline and hydroxyproline as well as 22 essential amino acids, are existed in BP, but its content and content proportions seriously vary according to the ecosystem (flower species, etc.), climate and even earth-soil type[1-6]. Even in the same region, BP extracts may show major differences in contents[7]. In addition, botanical environment (which is also related with geographical location and climate) and behaviors (plant choices) of bees are critical factors for contents and their efficiency [8,9].

Pascoal et al[10] evaluated 8 different commercial BPs for anti-microbial, anti-mutagenic, anti-oxidant and anti-inflammatory activities. They stated particular differencies on phenolic compounds and flavonoids. Furthermore, they showed antioxidant activities on animal livers and indicated variable degrees of activities for different kinds of BP. Leja et al[11] reported similar results for 12 different BPs and added that antioxidant activity was not correlated with phenolic compounds. Despite of these results, LeBlanc et al[12] claimed a direct correlation, oppositely. Eraslan et al[13] studied on propoxur (an insecticide)-applied mice and observed oxidative stress/injuries in particular tissues. Interestingly, they stated a significant decrease on oxidative stress/injuries in polen-propoxur group comparing with single- propoxur group.

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Some studies claimed that antioxidant activity is related with the degree of inhibiton of particular enzymes, hyaluronidase and monoamine oxidase[10,14]. These enzymes are called to be "oxidative" and inhibiting them is thought to be anti-oxidant and cause anti-aging action[15,16]. Pascoal et al[10] and Yildiz et al[14] stated that this inhibitory activity may depend on phenolic compounds, however, study of Araujo et al[8] showed that antioxidant effect of BP is mainly achieved by several compounds via multiple paths. The same issue was also stated by Markiewicz-Zukowska et al[17].

Potential anti-inflammatory effects of pollen were also a topic of focus. In an interesting study from Al-Salem et al[18], researchers focused on inflammatory responses in brain and neurotoxicity, that they did not only found a strong anti-inflammatory effect by alterations In particular cytokines, but also specific changes in enzymatic activities (i.e. inhibition of cyclooxygenase-2 and nitric oxide expression). Maruyama et al[19] evaluated effects of pollen on carrageenan-induced inflammation on rats by observing edema, nitric oxide (NO) levels and cyclooxygenase (COX) activity. Interestingly, water extracts of pollen did not cause any alteration, but ethanol extracts significantly inhibited COX-2 activity, decreased NO levels and reduced edema. Ekhteiari Salmas et al20 showed that these anti-inflammatory activity can be actually a "tissue protective" effect, that they reported pollen and many other natural products directly affects transcription in many tissues. Pascoal et al[10] reported variable anti-inflammatory activity of different pollens, since some types of pollens did not show activity, but some of them acted opposedly. In a recent wide study, researchers also showed anti-inflammatory activity, but they stated that it is dose-dependent and both effect and efficiency are strongly connected with BP type[21].

Pascoal et al[10] observed antimutagenic effects of polen on ethylmethanesulfonate-treated *Saccharomyces cerevisiae*. Abdella et al[22] studied about potential activity of propolis and pollen on cisplatin-induced chromosomal abnormalities in bone marrow tissues of mice, and they reported strong antimutagenic effects. They also noted that pollen itself showed relatively more activity comparing with propolis. Similarly, Tohamy et al[23] stated that pollen (more potent) and propolis resulted with significant antimutagenic and antioxidant activity after application on mice with cisplatin-induced renal, hepatic, and testicular damages. Sobral et al[24] also reported cytotoxicity against non-small cell lung cancer and cervical carcinoma cells. Recently, a few studies were published investigating BP compounds whether they, themselves, are potential chemotherapeutic agents for cancer treatment and have also a potential to act as a synergistic agent with anticancer drug or have a possible utility to decrease common adverse effects of anticancer agents. Kustiawan et al[25] reported a direct cytotoxic acitivity against human cancer cells, but their data was limited with a few BP types. Synergism is a totally different issue which is affected by many factors such as the type of the cancer and chemotherapeutic agent. Articles of Komosinska-Vasev et al[26], Wan Omar et al[27] opened a novel pathway of this potential utility, but studies are generally in vitro and for now, it is really hard comment on probable in vivo results. BP is good nutritious agent, so it is claimed that BP may be beneficial in cancer patients to avoid adverse effects[28]. Unfortunately, only a few studies such as Salles et al[29] and Münstedt et al[30] were published on this issue.

Interestingly, Garikou et al[31] found antibacterial activity on gram positives with agar dilution. Basim et al[32] also noted similar potent antibacterial activity against plant-pathogen bacteria. However, Erkmen and Ozcan[33] could not find any antimicrobial activity, but they noted that this effect might be dose-dependent. Of note, these researchers studied on various pollens from different geographical locations, components of pollen may vary, and it is possible that this could be an explanation for conflicting results. The study of Pascoal et al[10] supports this hypothesis that they reported variable antimicrobial activity according to the type of pollen. In addition, they also reported that potency of antimicrobial activity varies on the bacterial species (highest activity against *S.aureus*, and lowest activity against *P.aeruginosa*). Furthermore, antibacterial activity shows wide variability regarding to the methodology that researchers used[34]. So, it seems it is really difficult to observe antimicrobial activity. Notably, antifungal activity was also detected[34,35].

BP was also reported to be anti-atherosclerotic, hypolipidemic, hypoglycemic, fibrinolytic and inhibitor of platelet aggregation[34,36]. With these activities, BP has a huge potential in fighting against diabetes mellitus and other cardiologic and endocrinologic diseases. Although there are only a few articles, these studies were on animal and patient groups, and all these desired effects could be achieved by one shot, using BP. It

should be reminded that BP has also anti-oxidant effect via several mechanisms, and these all actions cannot be evaluated separately.

Interestingly, Yildiz et al[14] and Karampour et al[37] showed potential of BP to be used as a therapeutic in psychiatric diseases. However it remains unclear of which mechanisms are on the move. So it seems, BP is going to be a topic of researches in the future about these subjects.

Once again, these results indicate variations on components of pollen, but also it seems extraction protocol can be a serious factor that strongly affects the study results[38,39]. Even simple methods such as lyophilization and drying show differences in obtaining bioactive compounds, and these variations affect on potential biological activities[40]. A questionnaire should be done about these protocols whether the procedure somehow activates some components and/or materials themselves used in the protocols might result with false assessments (which might cause exaggeration on effects of pollen). A recent wide review article was published focusing on extraction methods for BP and their possible differences, and giving suggestive conclusions for optimal choice of extraction[41].

Pollen is very nutritious for bees, on the other hand there is a limited data on nutritious effects on humans. Faes et al[3] reported that some of the BP components can be beneficial for humans. In BP, there are several vitamins in various ratios. De Arruda et al[2] investigated different types of dried BP from diverse areas of South America, and found B complex vitamins with different ratios in BPs. On the other hand, recently, BP is thought to be an indicator of environmental pollution[42]. A study of Altunatmaz et al[43] found strong evidence for BP to be a great source of minerals, but also an important carrier of heavy metals, which can be toxic. Roman et al[44] and Sattler et al[45] also found supportive data. Furthermore, microbiological contamination and relevance with hygiene standards is another important point[46]. So, it is crucial to perform a preliminary analysis before consumption. Unfortunately, choice of analyzing techniques is still controversial and novel methods have still being published[47].

Another problem in BP consumption is that it is highly allergic. Although individuals are strongly recommended to be tested before use, still atopic and individuals that are inclined to allergies are not recommended to consume and type of BP[36].

In conclusion, more animal and even human researches are needed to observe the exact efficiency. It is crucial and unfortunately complicating factor that pollen is a very variable substance according to environmental factors such as geographic location, climate and ecosystem.

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