

REVIEW PAPER

Bee pollen in allergy and immunology. Short review

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S u m m a r y

Bee pollen is a natural resource – pollen collected by bees and stored in the beehive with various bee enzymes added as it is a mixture of plants pollen and bee saliva. It is rich source of various nutrients, among them exogenous amino acids. Therefore, it can be a good and natural dietary supplement. New possibilities for bee pollen usage arise every day, yet it can also be a threat. Although bee pollen can act as an immunostimulant and anti-allergic agent, it is also and maybe even primarily allergic or cross-reactive with many allergens. A number of bee pollen allergy cases was described worldwide. A caution is therefore needed before ingestion or any other form of administration, especially in case of children or individuals with atopic predispositions. Anti-allergic attributes and immunostimulation ability still need further research.

Key words: *bee pollen, bee pollen allergy, bee pollen immunology*

Bee pollen – what is it exactly?

Bee pollen is a natural resource – a pollen collected by bees and stored in the beehive with various bee enzymes added as it is a mixture of plants pollen and bee saliva. Its chemical compositions varies, depending on the plant source, but it has been proved to contain about 250 different chemical substances – amino acids, vitamins, micro- and macroelements, carbohydrates, nucleic acids, triglycerides, phospholipids, flavonoids [1, 2]. About 20% of bee pollen is

composed of amino acids with about 10% of essential amino acids [3]. An average of 30% consists of carbohydrates and another 26% of reducing sugars like fructose and glucose [3].

Bee pollen has many beneficial properties: antifungal, antimicrobial, hypolipidemic, anti-oxidative, anti-inflammatory, antiviral, immunostimulative [3]. It also modulates burn wound healing process [3]. The specific influences of bee pollen are strictly related to the plant source. As all the bee products (including bee pollen) are gaining popularity for both simple consumption and as possible medication it is remarkably important to know the composite properties of bee pollen. In our paper we present current knowledge both on immunological and allergic properties of bee pollen.

Bee pollen intolerance

Despite its many beneficial properties, in certain circumstances bee pollen can also be dangerous for people ingesting it. It can elicit allergic symptoms in people sensitive to different bee products like honey and, therefore, caution is advised. In a study involving 147 atopic patients and 57 healthy individuals who were submitted to skin allergy tests with bee pollen – it was found out that pollens contained in bee pollen retain their allergenicity despite the impact of bee salivary enzymes [4]. Puente *et al.* reported a case of eosinophilic gastroenteritis following 3 weeks long ingestion of bee pollen by woman allergic to honey [5], the diagnosis was supported by the revival of all the symptoms after stopping bee pollen ingestion. Lin *et al.* reported a case of 37-year-old woman with hypereosinophilia (13 400 per mm³). After 6 weeks of bee pollen ingestion, patient's complaints included general malaise, nausea, decreased memory, disorientation, diarrhoea, myalgia, pruritus. All symptoms resolved after stopping bee pollen ingestion. Skin tests revealed pollen allergy [6]. Bee pollen can show cross-reactivity not only with other bee products but also with many pollens and should not be consumed by people allergic to any of them and should be especially carefully given to children [7]. What is important, bee pollen consists not only of anemophilous plant pollens but also of entomophilous and therefore the cross-reactivity with various entomophilous plants like grasses is also possible [4, 8]. Greenberger *et al.* reported finding *Alternaria* spores within bee pollen sample [9] - it further widens the potential spectrum of allergenicity and increases the risk of acute allergic reaction after ingestion of bee pollen.

Martín-Munoz *et al.* described a case of immediate allergic reaction after bee pollen consumption in a 4-year-old boy, who has never before consumed any bee product and has developed allergic rhinitis two months after consumption. After a small spoonful of bee pollen, he complained about intense itching in mouth, oedema of tongue, pharynx and uvula with difficulties in swallowing. All symptoms disappeared one hour after administration of antihistamine drugs, further

skin tests revealed allergy to multiple pollens [10]. Another similar mild allergic reaction was reported by Greenberger *et al.*: a 56-year-old female developed palmar pruritus, dyspnoea with throat tightness and generalized urticaria after ingestion of a smoothie with bee pollen. She had a history of mild asthma and immunotherapy for allergic rhinitis caused by pollens, moulds, olive, mesquite and dust. Dyspnoea resolved one hour after administration of 25 mg of hydroxyzine while the rest of the symptoms persisted longer [9]. Basista *et al.* studied the prevalence of allergic reactions after bee pollen ingestion in a group of 493 Polish bee-keepers. Side effects after bee pollen ingestion were reported in two cases (0.41%) the first was local rash and the second abdominal pain. The same amount of respondents admitted being allergic to bee pollen. Side effects after bee pollen ingestion (both intolerance and allergy) were reported in 8 bee-keepers' family members (0.56%) [11].

Can bee pollen be a life threat?

Natural products are considered safe and only very limited individuals recognise possible health risks related to their consumption. Although bee pollen is beneficial in many ways as described in the introduction, it can also be a life threat for sensitised individuals. As written above, bee pollen can cause some mild allergic reactions, however, it can be a reason of anaphylaxis in certain sensitive individuals. Jagdis and Sussman described a case of anaphylactic reaction (eyelids, throat and lips swelling, shortness of breath, swallowing difficulties, feeling faint) in a 30-year-old woman with seasonal allergic rhinitis after consumption of a second dose of bee pollen. The skin tests revealed strong reactivity to bee pollen [12]. Similar case was also reported by Choi *et al.*: 40-year-old male with history of seasonal allergic rhinitis had anaphylactic reaction after ingestion of a tablespoon of bee pollen [13]. In the first case, the symptoms resolved after epinephrine and diphenhydramine administration, in the second epinephrine, chlorpheniramine and dexamethasone relieved symptoms.

The possible acute allergic reactions along with anaphylaxis show the need of extreme caution while administering bee pollen to people with diagnosed allergy (especially to pollens) or with signs and symptoms indicating the high possibility of allergy. Patients should be warned about possible effects of bee pollen ingestion and instructed about the correct behaviour in case of acute allergic reaction.

Can bee pollen be anti-allergic?

Medeiros *et al.* showed that bee pollen phenolic extract (BPPE) in an experimental model of allergy in mice has anti-allergic attributes. It decreases the allergic reaction by inhibiting ovalbumin specific antibodies (IgE and IgG₁) and further

decreases total number of cells as well as number of eosinophils in bronchoalveolar lavage. Probably the most important anti-allergic component of bee pollen is myricetin, a flavonoid that represents about 2% of BPPE [14]. Ishikawa *et al.* found out that daily ingestion of bee pollen by mice reduced IgE mediated activation of cutaneous mast cells. It is probably due to one of the lipid-soluble components - one of the flavonoids [15]. Ishikawa *et al.* had previously also described in vitro mast cells degranulation inhibition by blocking IgE binding and decrease in TNF- α production in mast cells [16]. Similar results were obtained by Moita *et al.* in an experiment on rat basophilic leukemic cells. *Echium plantagineum* L. bee pollen reduced the degranulation of those cells [17].

Immunostimulation

Bee pollen immunostimulating properties were proved by El-Asely *et al.* in their experiment on Nile tilapias, all experimental groups (fed with bee pollen) showed significant protection against infection with *Aeromonas hydrophila* when comparing with control group. Various tests showed increased immunological potency in the experimental groups increase in neutrophils and monocytes number and phagocytic activity [18]. Li *et al.* purified two carbohydrates from bee pollen (called CPP-1 and CPP-2) and investigated their influence on immunological system of mice, the main source of the pollen was *Crataegus pinnatifida*, a plant used in traditional Chinese medicine. It was found out that both carbohydrates in a dose dependent manner increase phagocytic properties of macrophages and cytotoxic activity of NK-cells, responsible among others also for cancer cells killing. Moreover, both substances proved to be potent stimulators of splenocytes proliferation. The CPP-2 provided better results with higher immunostimulative potential than CPP-1 [19]. Among many other ingredients bee pollen contains also specific bacteria, responsible for process of honey production, with *Lactobacillus kunkeei* as one of them. Asama *et al.* investigated the influence of *L. kunkeei* from various bee products (bee pollen among them) on the immunological potential both *in vitro* (mice Peyer's patch cells and splenic cells and CTLL-2 cell colonies) and *in vivo* in healthy human volunteers. The study proved the efficiency of *L. kunkeei*, isolated from bee products, for increasing IgA secretion as measured in human saliva and mice cell cultures [20].

CONCLUSIONS

Bee pollen is known as a rich source of different nutrients and has wide range of applications. New possibilities for bee pollen usage arise every day, yet it can also be a threat. Although bee pollen can act as an immunostimulant and anti-allergic agent, it is also and maybe even primarily allergic or cross-reactive with

many allergens. Therefore, caution is needed before ingestion or any other form of administration, especially in case of children or individuals with atopic predispositions.

Anti-allergic attributes and immunostimulation ability still need further research. Many questions about bee pollen need to be addressed, among them about the nature and potential of immunostimulation. Rich chemical composition of bee pollen, depending on many factors - plants source, region of world, bee species, should be thoroughly researched and the substances should be listed for further separate studies.

Ethical approval: The conducted research is not related to either human or animal use.

Conflict of interest: Authors declare no conflict of interest.

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PYŁEK KWIATOWY W ALERGI I IMMUNOLOGII. KRÓTKI PRZEGLĄD

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Streszczenie

Pyłek kwiatowy zebrany przez pszczoły i zmieszany z wydzieloną ich gruczołom ślinowym jest surowcem naturalnym. Jego bogaty skład, w tym także zawartość egzogennych aminokwasów, powoduje, że jest doskonałym suplementem diety. Chociaż przybiera możliwość zastosowań pyłku kwiatowego, należy zauważyć, że może on również stanowić zagrożenie. Posiada własności immunostymulacji oraz hamowania alergii, może jednak

powodować reakcje alergiczne związane z alergią na pyłek kwiatowy lub ze względu na reaktywność krzyżową z innymi antygenami. W skali świata opisano przypadki reakcji alergicznej w związku z pyłkiem kwiatowym. Należy zatem zachować szczególną ostrożność w przypadku spożywania pyłku kwiatowego, szczególnie u dzieci oraz ludzi obciążonych wywiadem alergicznym. Właściwości immunostymulacji oraz antyalergiczne wymagają dalszych badań.

Słowa kluczowe: *pyłek kwiatowy, alergia na pyłek kwiatowy, immunologia pyłku kwiatowego*