

Bee pollen properties: uses and potential pharmacological applications-a review

Abstract

Bee pollen is a food supplement widely used in the world due to the benefits promoted by the bioactive compounds present in it. In addition to the very attractive nutritional composition, the presence of phenolics, flavonoids, terpenes are responsible for the antioxidant activity, antimicrobial, antiinflammatory, possible action on benign prostatic hyperplasia, no cytotoxic. It is intended to show with this article the uses and potential of bee pollen application. Numerous studies are aimed at identifying these compounds in pollen samples around the world, because according to the region, climatic type, seasons, shift and bee species, the composition is influenced by the variety. The use of pollen is more recurrent in the food industry are comprehensively summarized in this review, but the biomedical could also take advantage of the potential that this product demonstrates.

Keywords: bee products, bioactive compounds, antioxidant activity, pharmacological uses

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Introduction

Foods are natural source of several health promoting substances with significant biological activities.¹ Recently, dietary flavonoids are attracting increasing interest based on *in vitro* and *in vivo* studies suggesting a variety of beneficial biological properties.² The bee pollen is one of bee products that has highlighted due to the presence of bioactive compounds associated with health benefits.³

Bee pollen is a mixture of flower pollen, nectar and bee secretions. It can be collected by beekeepers without damage to the beehive. This natural product, that has been gaining prominence, is recognized to be a valuable apitherapeutic product with potential for medical and nutritional applications.⁴ In fact it contains proteins, the 22 basic amino acids, carbohydrates, lipids, vitamins and minerals.⁵

The significative amount of phytosterols, carbohydrates, enzymes, nucleic and triterpene acids, vitamins and other biologically active substances in bee pollen provides anti-inflammatory, wound healing, cardiogenic, antiatherosclerotic and other pharmacological actions.⁶ Thereby bee pollen is considered as “only perfectly complete food”.⁷

The most important bioactive substances in bee-pollen are phenolic compounds and carotenoids. Phenolic compounds are responsible for the color of the grain and its characteristic bitter taste.⁸ Carotenoids are also important for color and for other biological functions, such as antioxidant activity, provitamin A activity, and enhancement of the immune system.

Nowdays, the major use of bee pollen is specialty food supplement but it has potential therapeutic benefits. Particularly, it has been used for a long time to manage benign prostatic hyperplasia (BPH) which is the most common disorder for older men,⁹ how demonstrated by Park et al.,¹⁰ that obtained satisfactory results using a herbal composition with bee pollen and *Panax ginseng* (ginseng) to the treatment of BPH. Therefore it is intended to show with this article the uses and potential of bee pollen application.

Bioactive compound, antioxidant activity and others effects

The chemical composition of bee pollen is directly influenced by the botanical diversity from which it was collected, as shown by Modro et al.¹¹ In addition to the botanical contribution, storage time, nutritional status of the plant and environmental conditions in the phase of pollen collection by bees also influence the composition.³ It should be noted that the action of a natural antioxidant depends on several factors, such as: reaction mechanism, experimental conditions and matrix heterogeneity.⁵

LeBlanc et al.,¹² identified *p*-hydroxybenzoic, *p*-coumaric, vanillic, gallic and ferulic acids in bee pollen from the United States. Menezes maintains that among the carotenoids found in bee pollen, α -carotene and β -carotene are predominant, and in a smaller amount cryptoxanthin, xanthophylls and flavoxanthin are predominant. It should be emphasized that the flavonoid and phenolic profile, both in quantity and variety, is directly related to the pollen types that make up the bee pollen.

Fanali, Dugo and Rocco¹ found nine polyphenols: *o*-, *p*-coumaric acid, ferulic acid, myricetin, cinnamic acid, quercetin, naringenin, hesperitin and kaempferol. All analytes, with the exception of *p*-coumaric acid and myricetin, which partially co-eluted with other pollen components, were also quantified in the sample. Lv et al.,¹⁴ identified pollen samples from the Qinghai-Tibetan Plateau by HPLC-DAD-APCI/MS, quercetin and campherol, with no routine and isoramnetin being detected.

Six 4-desmethylsterols, one 4-monomethylsterol, four 4, 4-dimethylsterols and another three triterpene alcohols were reported for the first time in the bee pollen. Significant difference was found in the contents of free and esterified triterpene alcohols between bee-collected pollens from the selected plant origins. The total triterpene alcohol levels in bee pollen oil fractions have been found to vary between 2.6g/100g and 20.4g/100g oil. Triterpene alcohols in the bee pollen oils were dominated by steryl esters (>67%). Concurrently,

esterified triterpene alcohols in lotus bee pollen oil fraction predominantly consisted of large amount of cycloartenol.¹⁵

Carpes et al.,¹⁶ evaluated the antioxidant activity after the use of Amberlite XAD2 resin for the purification of samples of bee pollen extracts, and even occurring a decrease of half of the phenolic compounds, the antioxidant activity was effective, by the DPPH method. In the case of β -carotene, a possible explanation is that the slight increase in antioxidant activity may have been the removal of polar compounds present in the extract, which in turn are more diluted, having a lower efficiency in the protection against lipid oxidation.

Fatrcová-Šramková et al.,¹⁷ tested the antioxidant profile only in ethanolic extract of monofloral pollen of poppy, canola and sunflower, verifying the best values for all parameters in canola pollen samples. The results of antioxidants obtained by Mohdaly et al.,¹⁸ showed that the radical ABTS test showed better activity than DPPH, such as the radical stereoselectivity and the solubility of the extract in different test systems as influencers of the extract's ability to react and eliminate different radicals.

The anti-inflammatory activity was assessment by indirect method of measuring the effect of inhibition of the reaction of catalysis by hyaluronidase, the results obtained were compared with those of another study with propolis, due to lack of studies with the same material, however the values for this aspect were smaller than those of propolis, where the researchers associated this fact with the lowest phenolic content.¹⁹

In the study about bioactivity of *Eucalyptus globulus* and *Salix atrocinerea* bee pollen extracts on rats showed that both species have antidiarrheal properties, reducing diarrheic excrement by about 30%. It be concluded that activity may be due to the polyphenolic constituents, especially quercetin and its derivatives, although other compounds can play a role in this activity and also be responsible for differences in results.²⁰

Pharmacological use

A broad range of therapeutic properties have been suggested to bee pollen, such as: antimicrobial, antioxidant, hepatoprotective, chemopreventive and anticarcinogenic, antiatherosclerotic, anti-inflammatory, anti-allergenic, and immunomodulatory activities.^{21,22}

According to the authors⁶ a composition of standardized substances of bee products –PH, PPHD and BP, are a promising source for development of new domestic drugs for use in urological practice.

Bharti et al.,²³ supplemented the diet of rats with bee pollen which showed antioxidant and protective effect when given along with antituberculosis drugs (rifampicin as well as isoniazid). It is thus observed that bee pollen has strong potential to provide protection against antituberculosis drugs-induced toxicity in rats as evidenced by improved histological parameters and rebuilding of the antioxidant/oxidative status.

Omar et al.,²⁴ from your research, suggested that BPE of Malaysian stingless bee, *L. terminata* is a potential chemopreventive agent and can be used as a supplementary treatment for chemotherapy drugs. BPE might be able to be used to potentiate the effect of chemotherapy drugs with the possibility to reduce the required dose of the drugs. Huang et al.,²⁵ reinforce this information, indicating the use of compound SCBPE could reduce the damage of liver and kidney caused by cisplatin by reducing the level of oxidative stress, inflammation

and apoptosis, and improving the antioxidant, anti-inflammatory and anti-apoptotic capacity of the body.

Furthermore, bee pollen as supplement can be combined with chemotherapy treatment to treat side effects of cancer as reported in a recent study by Salles et al.,²⁶ which showed that bee pollen was able to improve muscle mass and metabolism in undernourished rats.

Yildiz et al.²⁷ showed that use of bee pollen accelerated recovery from liver damage caused by carbon tetrachloride poisoning and it was therefore proposed as an alternative therapy for liver damage. Kolesarova et al.,²⁸ studied the effects of bee pollen on ovarian activity and showed that bee pollen is a strong regulator of ovarian activity in rats. Karampour, Hemmati, MAamir (2016) can be concluded that hydroalcoholic extract of bee pollen has anxiolytic properties through bonding to benzodiazepines in gamma-aminobutyric acid receptor, and thus moderates anxious reactions.

Mohamed et al.,²⁹ assessed the effects of bee pollen and/or date palm pollen suspensions on the glycemic state, testicular dysfunctions, oxidative stress and antioxidant defense system in diabetic male Wistar. It is may be attributed to the improvements in the glycemic state secondary to ameliorations in the insulin secretion and beta cell function as well as to enhancement of the testicular antioxidant defense system.

Al-Salem et al.,³⁰ and El-Ansary et al.,³¹ suggest that bee pollen has potential candidate for further studies for the development of new treatment strategies to autism. In the both studies was proved the bee pollen positive effect due to the biological properties of its components, in particular, phenolic compounds and amino acid composition, resulting to ameliorate oxidative stress, neuroinflammation, poor detoxification, and abnormal gut microbiota.

Cornara et al.,³² emphasize that studies aimed at refining the knowledge of action mechanisms from bee products are pivotal importance for developing applications of honeybee products to medicinal uses, because the complexity and variability in composition of these products raise the need of their standardization before safe and predictable clinical uses can be achieved.

The extracts of bee pollen collected from flowers of different angiosperms can be regarded as a promising therapeutic and nutritional natural food supplement. Its functional biological property is due to the high content of flavonoids and polyphenols and considerable radical scavenging capacity. However, more research and more experimental and clinical studies are required to verify the effectiveness of bee pollen extracts, using tests accepted by the Western medical establishment.²²

Conclusion

The bee pollen is a rich product in bioactive compounds which are associated innumerable therapeutic effects that be used to development food products or pharmaceutical. Due to many variations in function soil and climatic conditions, botanical source and storage and processing conditions, is relevant their phytochemical and botanical characterization.

Although there are no available product based-bee pollen commercially for pharmacological purposes it is noted that the scientific field has worked hard to elucidate the effects and action mechanisms the bee products. Thus new research on the characterization and application of the therapeutic properties of bee

pollen is strongly encouraged.

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Conflict of interests

Author declares that there is no conflict of interest.

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