

Bee Pollen

Subjects: Primary Health Care

Contributor: Jari S. Algethami, Aida A. Abd El-Wahed, Mohamed H. Elashal, Hanan R. Ahmed, Esraa H. Elshafiey, Eslam M. Omar, Yahya Al Naggar, Ahmed F. Algethami, Qiyang Shou, Sultan M. Alsharif, Baojun Xu, Awad A. Shehata, Zhiming Guo, Shaden A. M. Khalifa, Kai Wang, Hesham R. El-Seedi

Bee pollen is a natural cocktail of floral nectar, flower pollen, enzymes, and salivary secretions produced by honeybees. Bee pollen is one of the bee products most enriched in proteins, polysaccharides, polyphenols, lipids, minerals, and vitamins. It has a significant health and medicinal impact and provides protection against many diseases, including diabetes, cancer, infectious, and cardiovascular. Bee pollen is commonly promoted as a cost-effective functional food.

Keywords: bee pollen ; diseases ; functional foods

1. Introduction

Consumer expectations of natural products have been rising due to their proven nutritional value. Food manufacturers are also responding to the health trend of “you are what you eat”, especially in the areas of functional and health-beneficial products, for both prevention and treatment. The honeybee (*Apis mellifera* L.) produces several beneficial entities, including honey, propolis, royal jelly, bee venom, bee pollen, beehive air, and beebread. These products have been used in traditional medicine for thousands of years, and there is increasing interest in their application in modern medicine ^{[1][2][3][4][5][6][7][8][9]}.

Bee pollen is a combination of floral nectar, flower pollen, and enzymes, as well as salivary secretions from honeybees ^[4]. It contains a wide range of secondary metabolites, including proteins, carbohydrates, fatty acids, vitamins, polyphenols, phytosterols, carotenoid pigments, enzymes, and co-enzymes. Pollen’s secondary metabolites have antibacterial, antioxidant, anti-atherosclerotic, anticancer, antiallergenic, anti-fungicidal, chemopreventive, hepatoprotective, and immunomodulatory effects ^[10].

Bee pollen has played a role in combating metabolic disorders such as diabetes, obesity, hyper-dyslipidemia, and related cardiovascular complications ^[4].

In addition to the nutritive value of bee pollen, it also has a physicochemical composition (water, protein, and lipid content) and techno-functional properties (protein solubility, carbohydrate solubility, and emulsifying ability) that facilitate its food application. Additionally, its capacity to absorb oil allows it to function as a flavor retainer and mouthfeel enhancer, and contribute to consistency characteristics and the creation of product structures ^[11].

Bee pollen products have recently been developed as granules, pills, candy bars, oral liquids, and human tonics ^[12]. The natural antioxidant capacity of bee pollen enhances food preservation via the prevention of lipid oxidation ^[13]. Bee pollen is recognized as a medicinal commodity in Germany ^[14]. The usage of bee pollen in yogurt increases the shelf life and improves its appearance, taste, odor, and cohesiveness ^[15].

Moreover, bee pollen could be used in the cosmetic field, protecting cells from abnormal melanogenesis in skin disorders, and eliminating age spots, freckles, melasma, and malignant melanoma ^[16].

2. Application of Bee Pollen

2.1. Prostatitis Diseases

Prostatitis, or inflammation of the prostate, is a common condition that can be caused by bacterial or non-bacterial pathogenic causes ^[17]. In an in vivo study, pollen was found to have the ability to suppress various inflammatory pathways, including nuclear factor kappa-light-chain-enhancer of activated B cells (NF-κB), prostaglandin E2 (PGE2), and malondialdehyde (MDA) ^[17]. *Brassica campestris* pollen could help rats with prostate hyperplasia by affecting the expression of miRNAs including rno-miR184, which rose as the prostate improved ^[18]. In addition, four weeks of

administration of bee pollen or date palm suspension (100 mg/kg) improved male reproductive parameters such as testis weight, testosterone, luteinizing hormone (LH) and follicle stimulating hormone (FSH), as well as spermatogenesis, motility, and viability, in STZ-induced diabetic Wistar male rats [19].

As stated **Figure 1**, sixteen patents were filed between 1994 and 2021 on the use of bee pollen to improve prostate function, in the form of tablets, capsules, suspensions, powders, drops, and solutions. The composition includes bee pollen coupled with other natural sources (e.g., plants and bee products). The formulations can be used to treat several disorders associated with prostatic hyperplasia by reducing the prostate volume and alleviating lower urinary tract symptoms. The formulation is used for reducing the effects of prostate inflammation on male sexual function and enhancing male sexual function [20][21][22][23][24][25][26][27][28][29][30][31][32][33][34][35].

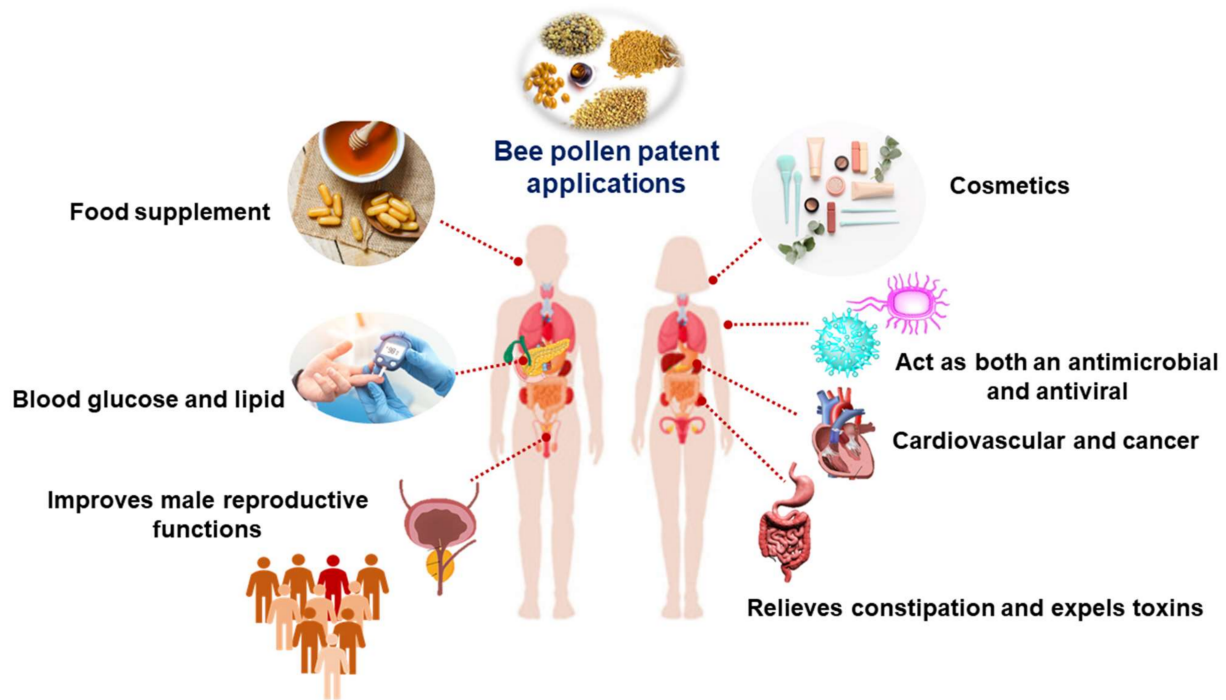


Figure 1. Bee pollen patent applications.

2.2. Diabetes Disease β

Bee pollen contains phenols and flavonoids, which inhibit carbohydrate-hydrolyzing enzymes such as amylase and glucosidase, as well as carbohydrate absorption in the small intestine, and decrease blood glucose levels significantly (**Figure 1**). Furthermore, postprandial blood glucose levels were lower after bee pollen intake [36]. In mice with diabetes mellitus, oral administration of pectic bee pollen polysaccharide from *Rosa rugosa Thunb* (Rosaceae) (RBPP-P) improved diabetic symptoms and protected the pancreas (Type 1). RBPP-P increased insulin secretion and functions through the stimulation of key transcription factors MafA and Pdx1 in cells. RBPP-P also increased β -cell proliferation, and upregulated the phosphorylation levels of p38, ERK, and AKT [37]. The phenolic compounds from bee pollen *Camellia sinensis* L. extract, including 3-O-[2',6'-di-O-(trans-*p*-coumaroyl)- β -D-glucopyranosyl]kaempferol, 3-O-[6'-O-(trans-*p*-coumaroyl)- β -D-glucopyranosyl]kaempferol, and gallic acid (GA), had a hypoglycemic effect for patients with type 2 diabetes. Through interactions with glucose transporters, the three phenolic compounds decrease glucose absorption and transport. In addition, molecular docking showed that phenolic compounds have the ability to form hydrogen bonds with D-glucose and amino acids [38].

2.3. Immunity-Related Disorders

The active compounds in bee pollen are vital for boosting the number and activity of humoral immune cells and phagocytes, increasing the number of red blood cells, accelerating antibody formation, and delaying the elimination of antibodies (**Figure 1**) [39]. Bee pollen polysaccharide CCP-1 and CPP-2 isolated from bee pollen *Crataegus pinnatifida* Bge improved the phagocytic rates and phagocytic indexes of macrophages. Moreover, CCP-2 stimulated splenocyte proliferation and NK cells [40]. Four hundred birds were fed with bee pollen at concentrations of 0, 0.5, 1, and 1.5% for five replicates in a fully randomized model. Immunoglobulin M (IgM) titers increased linearly with bee pollen dietary intake for 21 days, and similarly, thymus weight increased linearly with bee pollen dietary intake for 42 days, indicating that up to 1.5 percent bee pollen could be added to broiler feed until the age of 21 days to improve bird immunity [41][41].

2.4. Chronic Diseases

Polyphenols found in bee pollen have antioxidant and antiproliferative properties, as well as the ability to regulate cell proliferation and cause apoptosis (**Figure 1**) [42]. The steroid fraction of bee pollen derived from *Brassica campestris* chloroform extract induced apoptosis in prostate cancer PC-3 cells, resulting in cytotoxicity [43]. It has been reported that bee pollen has a synergistic effect with the chemotherapy drug cisplatin, which is used to treat breast cancer, and that it might be used as a supplement during treatment [42]. Melissa pollen displayed a substantial impact on the treatment of breast diseases when administered once a day [44]. The capsule/tablet also included wall-broken bee pollen and *Ganoderma lucidum* spore powder, which acts as an anti-tumor agent [45].

Heart and coronary artery diseases are examples of cardiovascular diseases. Atherosclerosis is an inflammatory and reactive process in the arteries, associated with high serum cholesterol, oxidative stress, blood clotting, and a disrupted renin–angiotensin–aldosterone system equilibrium. For 16 weeks, 54 ApoE-knockout female mice were fed diets rich in bee pollen ethanolic extract (dosage 0.1 g/kg body mass). The levels of total cholesterol (TC), asymmetric dimethylarginine (ADMA), oxidized low-density lipoprotein (ox-LDL), angiotensin-converting enzyme (ACE), and angiotensin-converting factor (ACEF) decreased significantly [41][46].

2.5. Microbial Diseases

Because bee pollen comprises flavonoids and phenolic acids, its ethanol extracts are beneficial against Gram-positive and Gram-negative bacteria such as *Staphylococcus aureus*, *Escherichia coli*, *Klebsiella pneumoniae*, and *Pseudomonas aeruginosa*, as well as fungi such as *Candida albicans* [47][48]. The usage of bee pollen and propolis inhibits the growth and reproduction of bacteria and microbes [49]. Wall-broken bee pollen honey wine is a stronger antibacterial agent that can be used to limit the growth and reproduction of dangerous bacteria such as *Helicobacter pylori* [50]. Bee pollen contains antibacterial and antioxidant components such as flavones and polysaccharides, and the flavone component can also suppress COX-2 activity in gingival tissues, making it an excellent anti-inflammatory agent [51]. Furthermore, bee pollen is utilized in toothpaste because of its ability to suppress germs and also reduce inflammation in the mouth, teeth, and gums, thus preventing and treating oral inflammation, and increasing oral immunity [52].

2.6. Applications in Food Industry

Bee pollen is used in food processing due to its nutritive, chemical, physical, and techno-functional properties. It has higher oil absorption capacity than water absorption capacity, low protein but high carbohydrate solubility, better emulsifying properties, and foam depressing activity [11]. Black pudding with bee pollen is a natural antioxidant source to prevent lipid oxidation [53]. Moreover, its addition to pineapple juice at 400 MPa increased the overall bioactive compounds such as phenolic and carotenoids within 15 min [54]. Due to its content of proteins, including essential amino acids, enzymes, coenzymes, large numbers of vitamins, and trace elements [55], bee pollen was used as a food supplement for older horses and prevented the reduction in hematological parameters seen in control horses; it increased the homeostasis of several lipid parameters, and improved the homeostasis of urea and plasma proteins [56].

2.7. Cosmetic Applications

Rose bee pollen has a substantial impact on acne therapy when taken as tablets, oral liquid, capsules, electuary, recreational food, or a beverage. It contains proteins, minerals, vitamins, vital amino acids, and fatty acids such as linoleic and linolenic acids [57]. Melissa bee pollen acts on skin cell trophism, wrinkle reduction, as well as freckle therapy [58]. *Ganoderma* bee pollen extract maintains skin moisture and smoothness, improves skin tension, and maintains skin youth [59].

3. Conclusions

Pollen from bees has been used since prehistoric times due to its remarkable medical potential. Bee pollen has gained considerable interest because of its proven nutritional value, particularly in the fields of functional and health-beneficial manufacturing. Many ailments, including diabetes, cancer, cardiovascular diseases, prostatitis, and microbial and immune diseases, have been treated with bee pollen. The use of bee pollen in bread, fried, stewed, and canned foods, pastries, and beverages increases the nutritional value of the product, as well as its antioxidant and sterilizing properties. Scientists should apply the results from patent reports in clinical trials.

However, there are limitations in the use of bee pollen-based products due to their complexity and variability, which highlight the need for standardization before safe therapeutic usage.

References

1. El-Seedi, H.R.; Eid, N.; El-wahed, A.A.A.; Rateb, M.E. Honey bee products: Preclinical and clinical studies of their anti-inflammatory and immunomodulatory properties. *Front. Nutr.* 2022, 8, 761267–761285.
2. Yosri, N.; El-Wahed, A.A.A.; Ghonaim, R.; Khattab, O.M.; Sabry, A.; Ibrahim, M.A.A.; Moustafa, M.F.; Guo, Z.; Zou, X.; Algethami, A.F.M.; et al. Anti-viral and immunomodulatory properties of propolis: Chemical diversity, pharmacological properties, preclinical and clinical applications, and in silico potential against SARS-CoV-2. *Foods* 2021, 10, 1776.
3. El-Wahed, A.A.A.; Farag, M.A.; Eraqi, W.A.; Mersal, G.A.M.; Zhao, C.; Khalifa, S.A.M.; El-seedi, H.R. Unravelling the beehive air volatiles profile as analysed via solid-phase microextraction (SPME) and chemometrics. *J. King Saud Univ.-Sci.* 2021, 33, 101449–101456.
4. Khalifa, S.A.M.; Elashal, M.H.; Yosri, N.; Du, M.; Musharraf, S.G.; Nahar, L.; Sarker, S.D.; Guo, Z.; Cao, W.; Zou, X.; et al. Bee pollen: Current status and therapeutic potential. *Nutrients* 2021, 13, 1876.
5. El-Wahed, A.A.A.; Khalifa, S.A.M.; Elashal, M.H.; Musharraf, S.G.; Saeed, A.; Khatib, A.; Tahir, H.E.; Zou, X.; Naggar, Y.A.; Mehmood, A.; et al. Cosmetic applications of bee venom. *Toxins* 2021, 13, 810.
6. El-Seedi, H.R.; Khalifa, S.A.M.; El-Wahed, A.A.; Gao, R.; Guo, Z.; Tahir, H.E.; Zhao, C.; Du, M.; Farag, M.A.; Musharraf, S.G.; et al. Honeybee products: An updated review of neurological actions. *Trends Food Sci. Technol.* 2020, 101, 17–27.
7. Aufschneider, A.; Kohler, V.; Khalifa, S.; El-Wahed, A.; Du, M.; El-Seedi, H.; Büttner, S. Apitoxin and its components against cancer, neurodegeneration and rheumatoid arthritis: Limitations and possibilities. *Toxins* 2020, 12, 66.
8. Khalifa, S.A.M.; Elashal, M.; Kieliszek, M.; Ghazala, N.E.; Farag, M.A.; Saeed, A.; Xiao, J.; Zou, X.; Khatib, A.; Göransson, U.; et al. Recent insights into chemical and pharmacological studies of bee bread. *Trends Food Sci. Technol.* 2020, 97, 300–316.
9. Mohamed, H.K.; Mobasher, M.A.; Ebiya, R.A.; Hassen, M.T.; Hagag, H.M.; El-Sayed, R.; Abdel-Ghany, S.; Said, M.M.; Awad, N.S. Anti-inflammatory, anti-apoptotic, and antioxidant roles of honey, royal jelly, and propolis in suppressing nephrotoxicity induced by doxorubicin in male albino rats. *Antioxidants* 2022, 11, 1029.
10. Denisow, B.; Denisow-Pietrzyk, M. Biological and therapeutic properties of bee pollen: A review. *J. Sci. Food Agric.* 2016, 96, 4303–4309.
11. Kostić, A.T.; Barać, M.B.; Stanojević, S.P.; Milojković-Opsenica, D.M.; Tešić, Ž.L.; Šikoparija, B.; Radišić, P.; Prentović, M.; Pešić, M.B. Physicochemical composition and techno-functional properties of bee pollen collected in Serbia. *LWT-Food Sci. Technol.* 2015, 62, 301–309.
12. Bogdanov, S. Pollen: Nutrition, functional properties, health. *Magnesium* 2012, 20, 350.
13. de Almeida, J.F.; dos Reis, A.S.; Heldt, L.F.S.; Pereira, D.; Bianchin, M.; de Moura, C.; Plata-Oviedo, M.V.; Haminiuk, C.W.I.; Ribeiro, I.S.; da Luz, C.F.P.; et al. Lyophilized bee pollen extract: A natural antioxidant source to prevent lipid oxidation in refrigerated sausages. *LWT-Food Sci. Technol.* 2017, 76, 299–305.
14. Linskens, H.F.; Jorde, W. Pollen as food and medicine—A review. *Econ. Bot.* 1997, 51, 78–87.
15. Karabagias, I.K.; Karabagias, V.K.; Gatzias, I.; Riganakos, K.A. Bio-functional properties of bee pollen: The case of “bee pollen yoghurt”. *Coatings* 2018, 8, 423.
16. Sun, L.; Guo, Y.; Zhang, Y.; Zhuang, Y. Antioxidant and anti-tyrosinase activities of phenolic extracts from rape bee pollen and inhibitory melanogenesis by cAMP/MITF/TYR pathway in B16 mouse melanoma cells. *Front. Pharmacol.* 2017, 8, 104.
17. Locatelli, M.; Macchione, N.; Ferrante, C.; Chiavaroli, A.; Recinella, L.; Carradori, S.; Zengin, G.; Cesa, S.; Leporini, L.; Leone, S.; et al. Graminex pollen: Phenolic pattern, colorimetric analysis and protective effects in immortalized prostate cells (PC3) and rat prostate challenged with LPS. *Molecules* 2018, 23, 1145.
18. Chen, X.; Wu, R.Z.; Ren, Z.M.; Tong, Y.L.; Chen, S.; Yang, F.; Dai, G.H. Regulation of microRNAs by rape bee pollen on benign prostate hyperplasia in rats. *Andrologia* 2020, 52, e13386.
19. Mohamed, N.A.; Ahmed, O.M.; Hozayen, W.G.; Ahmed, M.A. Ameliorative effects of bee pollen and date palm pollen on the glycemic state and male sexual dysfunctions in streptozotocin-Induced diabetic wistar rats. *Biomed. Pharmacother.* 2018, 97, 9–18.
20. Xu, Y. Rape Flower Alkali and Application Thereof. CN 106366014A, 1 February 2017.
21. Chen, G.; Kong, F.; Lv, H.; Cheng, F.; Sun, C.; Wang, B.; Gan, Y.; Wang, Y.; Li, L.; Duan, Y. A Chinese Medicinal Prescription for Treating Benign Prostatic Hyperplasia. CN 101590126A, 2 December 2009.

22. Liu, Y. A Kind of Bee Product Composition and Preparation Method Thereof. CN 108902852A, 30 November 2018.
23. Li, Z.F.F. Health Food of Purified Propolis, Royal Jelly, Bee-Pollen and Queen Bee Grub for Treating Prostatic Diseases. CN 101480412A, 15 July 2009.
24. Mao, R. Health Tablet Containing Rape Bee Pollen and Maca Powder and Preparation Method Thereof. CN 103622020A, 12 March 2014.
25. Li, Z.; Wu, K.; Tan, Z. Method for Manufacturing Health Composition of Bee Products and *Taxillus Chinensis*. CN 101836736A, 22 September 2010.
26. Guo, L. Method for Manufacturing Pollen Product for Treating Chronic Prostatitis, Prostate Dysfunction and Prostate Cancer. CN 101869592A, 7 October 2010.
27. Wang, M.; Lei, Q. A Medicated Liquor Containing Ganoderma and Bee Pollen. CN 1096444A, 21 December 1994.
28. Hu, A. A Prostate Dietetic Therapy Formula or Replacement Product. CN 103622006A, 12 March 2014.
29. Gou, C. *Lepidium Meyenii*-Containing Kidney-Tonifying and Prostate Disease-Treating Tablet. CN 104984330A, 21 October 2015.
30. He, P.; Liu, L.; Zhang, Q.; Zhang, Y. Functional Nutritional Food for Improving Male Sexual Function and Preparation Method Thereof. CN 113197301A, 3 August 2021.
31. Ma, H.; Wang, Y.; Kuang, H.; Lu, X. Capsule for Treating Prostate and Preparation Method Thereof. CN 111228369A, 5 June 2020.
32. Qian, Z. A Health Care Product for Inhibiting Prostate Hyperplasia and Its Preparation Method, Containing Male Pupa *Apis*, Larva of Queen Bee, and/or Pollen. CN 1432370A, 30 July 2003.
33. Jiang, M.; Jiang, L.; Jiang, Y.; Jiang, H. Bee Pollen Honeyed Pill and Its Preparation Method. CN 1596710A, 23 March 2005.
34. Bai, W. A Capsule Prepared from Propolis Powder and Bee Pollen and Its Preparation Method. CN 101116497A, 6 February 2008.
35. Wu, X.; Wu, Z. Preparation Method of Prostate Health Tea. CN 107372942A, 24 November 2017.
36. Daudu, O.M. Bee pollen extracts as potential antioxidants and inhibitors of α -amylase and α -glucosidase enzymes-in vitro assessment. *J. Apic. Sci.* 2019, 63, 315–325.
37. Yang, S.; Qu, Y.; Chen, J.; Chen, S.; Sun, L.; Zhou, Y.; Fan, Y. Bee pollen polysaccharide From *Rosa rugosa* Thunb. (Rosaceae) promotes pancreatic β -cell proliferation and insulin secretion. *Front. Pharmacol.* 2021, 12, 688073–688081.
38. Li, Q.; Ren, C.; Yan, S.; Wang, K.; Hrynets, Y.; Xiang, L.; Xue, X.; Betti, M.; Wu, L. Extract of Unifloral *Camellia sinensis* L. pollen collected by *Apis mellifera* L. honeybees exerted inhibitory effects on glucose uptake and transport by interacting with glucose transporters in human intestinal cells. *J. Agric. Food Chem.* 2021, 69, 1877–1887.
39. Verde, U.D.R.; Verde, R. Effect of bee pollen on the immunity and tibia characteristics in broilers. *Brazilian J. Poult. Sci.* 2013, 15, 323–327.
40. Li, F.; Yuan, Q.; Rashid, F. Isolation, purification and immunobiological activity of a new water-soluble bee pollen polysaccharide from *Crataegus pinnatifida* Bge. *Carbohydr. Polym.* 2009, 78, 80–88.
41. Attia, Y.A.; El-Hanoun, A.M.; Bovera, F.; Monastera, G.; El-Tahawy, W.S.; Habiba, H.I. Growth performance, carcass quality, biochemical and haematological traits and immune response of growing rabbits as affected by different growth promoters. *J. Anim. Physiol. Anim. Nutr.* 2014, 98, 128–139.
42. Omar, W.A.W.; Azhar, N.A.; Fadzilah, N.H.; Kamal, N.N.S.N.M. Bee pollen extract of Malaysian stingless bee enhances the effect of cisplatin on breast cancer cell lines. *Asian Pac. J. Trop. Biomed.* 2016, 6, 265–269.
43. Wu, Y.; Lou, Y. A steroid fraction of chloroform extract from bee pollen of *Brassica campestris* induces apoptosis in human prostate cancer PC-3 cells. *Phytother. Res.* 2007, 21, 1087–1091.
44. Liu, G. A Traditional Chinese Medicinal Composition for Treatment of Breast Disease and Its Preparation Method. CN 105380982A, 9 March 2019.
45. Zheng, J. Pharmaceutical Composition with Anti-Tumor Activity, and Its Preparation Method, and Application Thereof in Preparation of Anti-breast Cancer Drug. CN 105056238A, 18 November 2015.
46. Rzepecka-Stojko, A.; Stojko, J.; Jasik, K.; Buszman, E. Anti-atherogenic activity of polyphenol-rich extract from bee pollen. *Nutrients* 2017, 9, 1369.

47. Ilie, C.; Oprea, E.; Geana, E.; Spoiala, A.; Buleandra, M.; Pircalabioru, G.G.; Badea, I.A.; Ficaï, D.; Andronescu, E.; Ficaï, A.; et al. Bee pollen extracts: Chemical composition, antioxidant properties, and effect on the growth of selected probiotic and pathogenic bacteria. *Antioxidants* 2022, 11, 959.
48. Sawicki, T.; Starowicz, M.; Kłębukowska, L.; Hanus, P. The profile of polyphenolic compounds, contents of total phenolics and flavonoids, and antioxidant and antimicrobial properties of bee products. *Molecules* 2022, 27, 1301.
49. Li, B.; Chen, H.; Chen, G.; Yin, H.; Feng, H.; Li, K.; Ye, H.; Gao, X.; Wang, C. Antiviral Pollution-Free Plant Nutrient Solution. CN 105399564A, 16 March 2016.
50. Mi, Y. Wall-Broken Bee Pollen Honey Wine and Preparation Method Thereof. CN 111454811A, 28 July 2020.
51. Song, H.; Wang, H.; Chen, Y. Mouthwash for Preventing and Treating Gingivitis and Its Preparation Method. CN 113633604A, 12 November 2021.
52. Cao, G. Bee Pollen Health-Care Toothpaste. CN 104706549A, 17 June 2015.
53. Anjos, O.; Fernandes, R.; Cardoso, S.M.; Delgado, T.; Farinha, N.; Paula, V.; Estevinho, L.M.; Carpes, S.T. Bee pollen as a natural antioxidant source to prevent lipid oxidation in black pudding. *Lwt* 2019, 111, 869–875.
54. Zuluaga, C.; Martínez, A.; Fernández, J.; López-Baldó, J.; Quiles, A.; Rodrigo, D. Effect of high pressure processing on carotenoid and phenolic compounds, antioxidant capacity, and microbial counts of bee-pollen paste and bee-pollen-based beverage. *Innov. Food Sci. Emerg. Technol.* 2016, 37, 10–17.
55. Attia, Y.A.; Al-Hamid, A.E.A.; Ibrahim, M.S.; Al-Harthi, M.A.; Bovera, F.; Elnaggar, A.S. Productive performance, biochemical and hematological traits of broiler chickens supplemented with propolis, bee pollen, and mannan oligosaccharides continuously or intermittently. *Livest. Sci.* 2014, 164, 87–95.
56. Kędzierski, W.; Prof, A.; Janczarek, I.; Prof, A.; Kowalik, S.; Franczyk, M.; Wawak, T.; Borsuk, G.; Prof, A.; Przetacznik, M. Bee pollen supplementation to aged horses influences several blood parameters. *J. Equine Vet. Sci.* 2020, 90, 103024.
57. Zhou, F.; Zhang, N.; Yin, X.; Zhao, L.; Jiafei, Q.; Ba, J.; Li, S.L.R. Rose Bee Pollen Functional Food for Improving Acne. CN 110115383A, 13 August 2019.
58. Zhou, Y.; Zheng, G.; Jia, J.; Lu, J. Double-Glue Pollen Food with Functions of Enriching Blood, Beautifying Face and Nourishing Skin and Preparation Method Thereof. CN 200910153376A, 19 October 2009.
59. Cheng, J.; Cheng, G. Anti-Aging Cream of Ganoderma Pollen. CN 103893101A, 2 July 2014.

Retrieved from <https://encyclopedia.pub/entry/history/show/62068>