Promising directions for the use of pollen in preventive nutrition

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Abstract. The ways to solve a global problem - preventive-metabolic processes of the body through nutrition are discussed at the article. The purpose of the article is to substantiate promising directions for the use of bee pollen in nutrition. Samples of polyfloral pollen of various collections were selected: light (LPF), dark (DPF), lipophilic extract (LPI) and lyophilized extract (IZ). Complex lipids are studied. The expediency of the use of dark bee pollen in the diet for the prevention of diseases associated with metabolic disorders in the membranes of nerve cells, and light bee pollen for the prevention of diseases associated with protein metabolism disorders in the human body are proved.

1 Introduction

Bee products are a unique creation of nature: of the symbiosis of plants and bees. Bee products, as biologically active creations (honey, propolis, flower pollen or pollen tips, bee bread, royal jelly, bee venom, wax) - combine the essence of plant and bee origin, which ensures their uniqueness. Bees need these products generally, but a person is considering the possibility of using them in a wider range. They are used for dietary and therapeutic purposes; lately technologists and functionalists have begun to pay great attention to these products. Bee products should always be of high quality. It is naturalness that should be protected and achieved in every bee product. Pollen and parchment are necessary for bees, including young ones. With the appearance of the first pollen in the nest, bees begin to grow a "baby". They produce royal jelly and feed the brood, secrete wax and build honeycombs, produce enzymes, specific fatty acids and other substances that make up the biologically active secrets of their glands [1]. Recently, a great interest among the products of beekeeping is caused by bee stalk. Bees collect pollen from flowering plants and bring it to the hive during the season, turning it into a pollen crop. It has a high humidity, up to 25-35%, which depends on the amount of nectar (honey) and the secretions of the glands that the bee uses in the formation of the foot. A freshly harvested puff must be preserved. The most common method of pollen stabilization is drying. Pollen dried at a higher temperature contains fewer sugars, free sulfhydryl groups (active amino acids and protein substances).

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Flower pollen collected by bees has many useful properties, does not have a toxic effect on the body. Studying the development of the food industry, a promising direction of processing plant raw materials may be pollen crop, as an important component of preventive human nutrition. In this work, complex lipids of flower pollen have been studied from the point of view of their use in the prevention and treatment of certain alimentary diseases.

2 Materials and Methods

The basis of research were the samples of pollen collected by pollen collectors with a solar thermal camera. The technology of collecting the lining was carried out in strict accordance with GOST [2]. The collection period was 2 months from May 20 to August 03, 2021. For the content of complex lipids four samples of pollen were studied: light polyfleric (LPF), dark polyfleric (DPF), lipophilic extract of pollen (LPI) and lyophilized extract of pollen (LZ). Light polyfleric (LPF) pollen was obtained mainly from acacia and small-leaved linden in late May, early June. In color, it was predominantly white with a greenish tinge. Dark polyfleric (DPF) pollen was obtained from honey plants of late flowering, the color corresponded to green and dark gray. Lyophilized Pollen Extract (LZ) is a dried ethanol extract of pollen: 10g of pollen dried in a thermostat to a constant mass was extracted with an ethanol solution (800 ml/l) using a shaker at a temperature of 40 ° C and a speed of 150rpm for an hour. The filtered extract was dried in a rotary evaporator (40oC and a vacuum of 600 mmHg) [3]. Lipophilic pollen extract (LPI) is an extract of native pollen obtained by a mixture of chloroform and methanol (2:1 vol.) [4]. Analysis of the lipid profile of extracts. The extract was further analyzed by gas chromatography with a mass spectrometric detector [5].

3 Discussion

The problem raised in this article is related to the use of pollen in the prevention of the most common alimentary diseases based on metabolic disorders. Studies conducted by D.K. Zabolotny Institute of Microbiology and Virology on the use of flower pollen in metabolic processes have established a close relationship with the phospholipid composition, firstly, and with the degree of hormonal imbalance in the body [6]. This effect significantly depends on protein metabolism disorders, which in turn is associated with a number of external causes. Among these reasons is the fat component of the food consumed. It has been established that problems arise where food is rich in carbohydrates [6], primarily starch (rice, potatoes, bread) and low in fat (12% energy), fat-soluble vitamins, fresh vegetables, fruits. Secondly, it is characteristic when eating food that contains a lot of high-calorie fats. Finally, elementary obesity is also a factor of danger, an increase in the weight/height index with aging. Hence, it becomes clear that, when starting using flower pollen for preventive nutrition, it is necessary in each specific case, first of all, to normalize the influence of exogenous factors associated with the fat component of the food consumed, and correctly determine the composition and structure of pollen grains by complex lipids - phospholipids.

From the general characteristics of phospholipids, it should be noted that they are widely distributed in nature, and as the main structural components they are part of the cell membranes of animals, plants and microorganisms, determining their structure and permeability, as well as the activity of membrane enzymes. Various biological membranes have a certain composition of phospholipids, which changes for some organs with aging and a number of pathological conditions of the body, such as atherosclerosis, etc. The lipids

of flower pollen are effective for restoring the body's defenses. They belong to the little-studied components of flower pollen from the point of view of their use in the prevention of aging and a number of pathological conditions of the body (atherosclerosis, neoplasms, including malignant).

By their nature, lipids are fat-like substances that are part of all living cells and play an important role in life processes. Being one of the main components of biological membranes, lipids affect the permeability of cells and the activity of many enzymes, participate in the transmission of nerve impulses, in muscle contraction, the creation of intercellular contacts, in immunochemical processes, etc.

4 Results

In the work, the lipid composition of various pollen samples was studied. The fat component of flower pollen for two states which differ significantly in terms of the technological processes of collection, conservation treatment and storage is presented in Table 1.

Table 1. Lipid composition of different pollen samples, %.

Lipid composition	Light polyfloral (LPF)	Dark polyfloral (DPF)	Lipophilic pollen extract (LPI)	Freeze-dried pollen extract (LZ)
Phospholipids	49.1	49.9	55.6	75.5
Free cholesterol	6.6	5.0	3.9	5.3
Non-Esterified Fatty Acids (NEFA)	13.0	8.2	7.5	2.7
Triacylglycerides	14.7	10.0	3.6	6.4
Cholesterol esters	13.3	20.2	0	5.3
Diacylglycerides	3.2	6.7	0	0
Monoacylglycerides	0	0	29.4	4.9

As can be seen from Table 1, about 50% of the fat components of pollen belong to phospholipids and are significantly less than free cholesterol, cholesterol ether, NEFA, as well as triacylglycerides and diacylglycerides, and there are no monoacylglycerides at all.

The content of phospholipids significantly increases in lipophilic and lyophilized pollen extract (55.6% and 75.5%, respectively). In this case, the content of free cholesterol decreases from 6.6% to 3.9 and 5.3% and cholesterol esters from 13.3% and 20.2 to 5.3%. The content of triacylglycerides in the extracts decreases from 14.7 and 10.0% to 3.6 and 6.4%, and diacylglycerides are completely absent in these extracts, which is explained by the appearance of monoacylglycerides in the extracts (29.4 and 4.9%, respectively).

Comparing the data in Table 1 on the content of free cholesterol and cholesterol esters, it should be noted that cholesterol, an organic compound from the steroid class, is usually found in plants in small quantities (with the exception of seed oils and pollen). The increased content of cholesterol in pollen compared to other plants and especially cholesterol esters makes pollen an important source of biosynthesis in the body, because the most important biochemical function of cholesterol is its transformation into the hormone progesterone in the placenta, testes, corpus luteum and adrenal glands, and this transformation opens the chain of biosynthesis of steroid sex hormones and corticosteroids. In addition, cholesterol metabolism leads to the formation of bile acids and vitamin D3. It also participates in the regulation of cell permeability and protects red blood cells from the action of hemolytic poisons. It is found in large quantities in lipids of nervous tissue (where it is associated with structural components of the myelin sheath of nerves), sperm cells and

liver (the main organ of cholesterol biosynthesis in the body), in the adrenal glands, sebum and cell walls of erythrocytes.

Table 1 also shows the high content of cholesterol esters in dark pollen (20.2%), which are in the form of esters with higher fatty acids in the blood plasma and serve as a carrier during their transportation.

The light and dark polyfler pollen contains a significant amount of triacylglycerides, which make up the bulk of natural neutral fats. Triacylglycerides are relatively poorly soluble in water and by themselves do not show a tendency to form highly dispersed micelles. However, their hydrolysis and the formation of diacylglycerides and monoacylglycerides, which have a noticeable polarity and, due to the presence of free hydroxyl groups, easily form micelles, occurs under the action of lipases present in the juice of the pancreas.

The content of diacylglycerides in the dark polyfloral pollen extract is twice as high as in the light polyfloral pollen extract and there are completely no diacylglycerides in lipophilic and lyophilized pollen extracts.

The content of monoacylglycerides, on the contrary, is completely absent in the light and dark polyfleric pollen extract, but in large quantities (~ 30%) in the lipophilic extract of the pollen.

Thus, a general analysis of the fatty components of light and dark pollen samples allows us to conclude that a dark pollen extract containing a greater amount of phospholipids, cholesterol esters and diacylglycerides has a greater therapeutic effect on the membranes of nerve tissue cells.

Table 2 presents the results of the phospholipid structure of various pollen samples.

Table 2. Analysis of the structure of pollen phospholipids, %.

Lipid composition	**Light polyfloral (LPF)**	**Dark polyfloral (DPF)**	**Lipophilic pollen extract (LPI)**	**Freeze-dried pollen extract (LZ)**
Phospholipids				
Gangliosides + fragments of fl.	7.7	30.8	4.6	0
Phosphatidylserine	7.7	0	9.1	25.0
Sphingomyelin	7.7	0	4.6	0
Phosphatidylcholine	61.5	30.8	36.4	50.0
Phosphatidylinositol	7.7	0	9.1	25.0
Phosphatidylethanolamine	7.7	7.70	13.6	0
PEA derivative	0	7.7	0	0
Lysophosphatidic and phosphatidic acids	0	7.7	0	0
Cerebrosides	0	15.4	22.7	0

It can be seen from the table that the basis of the structure of the light pollen lining is phosphatidylcholine, whose main function in the body is to participate in the construction of biological membranes of the liver, sperm, blood, brain matter, adrenal glands. It is two times less in the DPZ and LPI and half of the composition in the lyophilized pollen extract compared with the light one. Its use inside is known for diseases of the nervous system, general loss of strength, anemia. The second component of phospholipids containing choline is sphingomyelin, which is 7.7% in the light leg, and not found in the dark leg. Thus, the total amount of phosphatidylcholine and sphingomyelin in the light and dark skin is 69.2 and 30.8%, respectively. Choline, which is part of phospholipids, serves as a source of methyl groups in the synthesis of methionine, one of the essential amino acids.

Acetylcholine is synthesized from it, one of the most important chemical transmitters of nerve impulses, it prevents severe liver diseases that occur during its fatty degeneration.

The absence or lack of essential amino acids in human food leads to disruption of protein biosynthesis, slowing down the growth and development of the body and severe functional disorders. Sphingomyelin is two times less than in the light leg, it is contained in the lipophilic extract of the pollen, and it is completely absent in the lyophilized extract [7].

As can be seen from Table 2, a large amount of dark pollen (30.8%) and light pollen (7.7%) contains another a class of glycolipids - gangliosides, a complex, carbohydrate-rich lipids with extremely large molecules. They are usually found on the outer surface of cell membranes, especially in nerve cells. Structurally, gangliosides are similar to cerebrosides, which contain 15.4% in the dark pollen extract, and they are completely absent in the light pollen extract. In the lipophilic extract, cerebrosides make up the largest amount - 22.7%, in the lyophilized extract they are absent.

5 Conclusion

Thus, analyzing the composition of phospholipids in the pollen lining of all samples, we can make an encouraging conclusion about the expediency of using dark pollen extract in nutrition for the prevention of diseases associated with metabolic disorders in the membranes of nerve cells, and light fiber for the prevention of diseases associated with protein metabolism disorders in the human body.

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