

# PROSPECTS FOR THE USE OF APIPRODUCTS IN HUMAN HEALTHY NUTRITION

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## Abstract

It has been established, that the development and implementation of the practice of using biologically active components of nutrition is one of the areas of modern dietetics, which are developing dynamically. Apiproducs are a very promising source of biologically active substances. Fundamental studies of domestic and foreign scientists have proven their high biological value, versatile pharmacological activity (anti-inflammatory, antimicrobial, analgesic, antioxidant, immunostimulatory, anti-radiation, etc.). The use of apiproducs for the prevention and treatment of a number of human diseases is a comprehensively studied phenomenon in terms of beekeeping, botany, chemistry, microbiology, pharmacology, medicine and pharmacy.

It has been proved, that the action of individual apiproducs and their components allows to use them effectively in practical apitherapy. Because these products differ significantly depending on their chemical composition, they are divided into two groups. The first includes honey, flower pollen, perga (a product of conservation of flower pollen in a hive) and, in part, drone brood. As mixtures of valuable BAS and metabolites, they are used mainly to increase the biological value of traditional foods and create new compositions. The second group includes bee venom, propolis and, in part, royal jelly, which are therapeutic agents by their nature and are used to correct physiological functions and metabolism, have regulatory effects, and their action is realized through the effect on the lipid matrix of biological membranes and membrane proteins. It has been established, that the use of these food components in health nutrition and production of health and medical foods is a promising area.

**Keywords:** apiproducs, apipreparations, health food, special products of preventive action, honey, propolis, pollen.

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## 1. Introduction

It is generally accepted, that in order to optimally ensure its functioning, the human body must receive about 600 important substances (nutrients) daily. These include amino acids, fatty acids, vitamins, macro- and micronutrients, organic acids, bioflavonoids, carotenoids, dietary fiber and other substances. Each of these substances occupies a certain place in the complex harmonious mechanism of biochemical processes. Almost all organic and inorganic compounds that enter the human body with food have one or another biological property.

There is no product in nature that has all the necessary components for the human body (except breast milk) and only a combination of different foods in the daily diet can provide the full range of essential nutrients. Therefore, the processes of their metabolism depend on the amount and ratio of these nutrients.

Knowledge of the laws of metabolism of physiological processes, occurring in the human body, allows for targeted impact on them, in order to prevent many diseases. In this case, nutrition is considered as one of the important factors in disease prevention and treatment of patients [1].

## 2. Analysis of literature data and problem statement

In recent years, scientific ideas about the essence of nutrition have been supplemented by data on the role of minor components of diets in the development of the theory of *optimal nutrition*.

Based on the assessment of diets in different regions of the world and identifying trends in meeting the nutritional needs of human in the process of its evolution, it has been investigated, that in the modern civilized world there was a sharp (2–3 times) reduction in food consumption due to reduced energy consumption. The result was a lack of the body of certain, so-called minor, biologically active components of food. A sufficient number of them are presented only in such a complex of food, which contains 5–6 thousand kcal in the daily balanced diet. This amount of food was consumed by human only in the earlier evolutionary period. Numerous scientific studies [2–5] have shown that a deficiency of minor food components contributes to a decrease in human health. In this regard, it becomes important to choose alternatives to meet food needs – reducing the amount of food consumed by reducing the energy consumption of modern human or getting all the necessary set of nutrients (including minor). Yes, it can be solved only by developing recommendations for a rational combination in the diet of healthy and sick people of traditional products with various biologically active additives (nutraceuticals and parapharmaceuticals). This, in turn, will compensate nutrient deficiency. [1–5].

Currently, the development and implementation of the practice of using biologically active components in diets and creating food compositions using them (dietary and special purpose products) is one of the most dynamically developing areas of modern dietetics. Quite a promising source of such biologically active substances is apiproducs (from the Latin *apis* bee+product) (AP) [2–4]. A significant number of scientific papers [6–11] is devoted to the study of their importance in human nutrition, analysis of promising areas of application, in particular in the creation of special dietary, preventive and curative foods, their impact on the human body. In this regard, the analysis and study of the nutrient composition of the components of AP, analysis of the specifics of their physiological effects on the human body, the study of the most important areas for use in health, prevention and therapeutic diet are very relevant and necessary.

## 3. Research aim and tasks

The aim of the article is to study the properties of AP and identify ways to further study and implement them in human health nutrition programs.

To achieve this goal, the following tasks were formulated:

- to conduct a thorough analysis of scientific research on the nutritional and biological value of AP;
- to investigate the feasibility of using AP in the development of special and dietary products, to determine the main prospects for this;
- to determine the prospects for further research on the use of AP in health and medical nutrition.

## 4. Research materials and methods

The information base for the research is the results of scientific research, presented in publications on medical and biological properties of apiproducs. The methods of scientific research, analysis, synthesis, induction and deduction, generalization, etc. were used in writing the article. The definition of conceptual approaches to the use of apiproducs and scientific development and modeling of the composition of new products with high biological value, which, in turn, will contribute to the nutritional harmony of the daily human diet, was given.

## 5. Research results and discussion

As a result of the analysis it has been established, that the use of AP as a health remedy has been known for a long time, in ancient China, India and Greece and the Roman Empire drugs for human treatment were prepared on the basis of honey, wax, flower pollen. In the 19<sup>th</sup> and 21<sup>st</sup> centuries, beekeeping grew into a highly profitable branch of agriculture, which currently supplies honey, propolis, flower pollen (bee pollen), royal jelly, bee venom, wax [1, 3].

Breeding of bees and selection of products of their vital activity is carried out in the conditions of use of modern advanced technologies. It should be noted, that considerable attention is paid to all substances, obtained by the activity of bee colonies in full symbiosis with the environment. In the middle of the twentieth century, a scientific basis for the development of science – apitherapy – was created. The scope of AP application in many areas of medicine began to expand: gastroenterology, cardiology, endocrinology, ophthalmology, immunology, etc.

The intensive development of beekeeping, which makes it possible to obtain in Ukraine annually up to 30–35 thousand tons of commercial honey, 1.5 thousand tons of wax, 3 thousand tons of pollen, 15–20 tons of royal jelly, up to 20 kg of bee venom, contributes to the progress in this direction. These products are valuable raw materials for the food and pharmaceutical industries, which in recent years have increased the range and volume of production of various food and pharmaceutical products of beekeeping (apipreparations) [10, 12].

It has been proved, that beekeeping is of great importance as:

- sources of highly valuable food (honey, flower pollen);
- important raw materials for food, pharmaceutical, cosmetic, cosmetological industry (propolis, flower pollen, royal jelly, wax);
- means of increasing the yield (pollination) of crops;
- raw material base for the production of medicinal AP;
- means of therapy – treatment with the use of AP.

Fundamental studies of domestic and foreign scientists [2, 11, 13–15] proved the high biological value of AP, which is characterized by diverse pharmacological activity (anti-inflammatory, antimicrobial, analgesic, antioxidant, immunostimulatory, anti-radiation, etc.).

The application of AP for the prevention and treatment of a number of human diseases was studied, analyzed and generalized in terms of beekeeping, botany, chemistry, microbiology, pharmacology, medicine and pharmacy. It, in turn, has become a new specific area of medical practice, called “apitherapy”, i.e. treatment with the use of AP.

Based on the general theoretical justifications of the multifaceted preventive effect of apipreparations on the body, a number of authors [16] identify the following three provisions, which in no way exclude, but on the contrary, complement each other:

- the presence of a large number of biologically active substances in a well-balanced state by nature in AP. It is with these circumstances that most scientists attribute the positive effects of AP on the regulation of functions, metabolism, immunostimulating, antioxidative, detoxifying, radioprotective, geroprotective, cardiotropic and other properties. Thus biologically active substances (BAS) are understood as not simply all natural substances or products, but those, which are capable to change a functional condition of physiological systems of an organism even in rather low concentrations. The group of BAS AP includes vitamins, bioflavonoids, carotenoids, enzymes, hormone-like substances, trace elements, essential amino and fatty acids, some proteins, peptides, etc.;
- the additive theory (from the Latin. *Additio* – add), which provides for the importance of intermediate metabolic products (metabolites) that enter the human body along with products of natural origin, deserves due attention. They, in turn, under certain conditions are able to normalize the disturbed metabolic cycles. In addition, it should be noted, that the complex receipt of certain components of the AP, they have a synergistic effect;
- there is a hypothesis that in different AP is from 1–2 % to 10–12 % of unidentified substances, the effect of which on the human body can be quite significant. Confirmation of this hypothesis is the fact that in recent years a number of new substances have been discovered in royal jelly, propolis, bee venom. Thus, in royal jelly, scientists have discovered a previously unknown

gamma globulin, which has immunostimulatory properties and increases the life expectancy of laboratory animals by 30 %.

From the standpoint of these three general theoretical positions, it is possible to more fully understand the importance of AP for human recovery.

However, it should be noted, that the mechanisms of action of individual AP and their components depend on the chemical structure of the active principles, doses and methods of introduction into the human body. The study of these mechanisms allows more effective use of AP in practical apitherapy. Since AP differ significantly from each other, depending on their chemical composition, they are divided into two groups.

The first includes honey, pollen, perga (a product of conservation of pollen in a hive) and partly royal jelly and drone brood. As mixtures of valuable BAS and metabolites, these products are used mainly to increase the biological value of traditional foods and create new compositions. They are often the basis for the creation of apiphytocompositions and are used as dietary supplements or as products for therapeutic and prophylactic purposes. The second includes bee venom, propolis and partially royal jelly that are remedies by nature. They are used to correct physiological functions and metabolism, have regulatory effects. Their action is realized through the effect on the lipid matrix of biological membranes and the state of membrane proteins. The dose of these AP or their nutrients is of great importance: in large doses they cause disintegration of intracellular processes, in smaller ones – their activation and normalization [17]. Now there is a lot of evidence that AP can significantly affect both metabolic processes and the system of regulation (adaptation) of the functions of organs and tissues of the human body, which determines their health properties.

It has been found, that AP from propolis (water-alcohol extracts) contain a significant amount of biologically active substances, in particular low molecular weight phenolic compounds, aromatic substances, flavonoid glycosides, catechins, carotenoids, chlorophyll. They are recommended for use as natural preservatives and antioxidants in the manufacture of apiadditives from the homogenate of drone larvae in the form of pastes and powders to increase their shelf life [18–20].

According to the analyzed standard [21], flower pollen (bee pollen) contains a multicomponent composition – essential amino acids, essential fatty acids, phospholipids, phytosterols, tocopherols, B vitamins, flavonoids, phenolic acids, near 50 microenzymes – biological catalysts for enzymes that accelerate chemical reactions.

Antibacterial properties of pollen have been proven against 27 strains of microorganisms. It has a positive effect on the central nervous system, helps to normalize the function of the heart muscle, liver, digestive system, lungs, endocrine glands and other organs [1, 4, 12, 16]. Long-term clinical trials have shown that the above product is a valuable and promising adjuvant in the treatment of many diseases of the internal organs. It is characterized by a multifaceted positive metabolic effect with cyto-, organoprotective properties. In our opinion, in its natural form, its use should be considered as a dietary supplement [2, 3], this product has a generally positive effect on the functional state of organs and systems, negatively affected by factors of various etiologies (causes). It has been established, that the duration of its use may be different depending on the characteristics of the disease, age, physiological condition and the adequacy of the body's perception of this product.

Based on the analyzed, we can state that flower pollen (bee pollen) is a valuable natural source of a wide range of biologically active substances. The peculiarity and originality of its chemical composition is the basis for the development of recipes for functional compositions, such as instant porridge based on cereals (rice, corn, semolina), which should be prepared on the basis of rapid steaming [21].

*Drone brood*, one of the least studied products of beekeeping, has recently become the subject of meticulous attention of many researchers.

The results of studies of the chemical composition of drone brood biomass showed that their composition is close to that of royal jelly in terms of mineral content (Potassium, Sodium, Calcium, Phosphorus, Manganese, Zinc), B vitamins, beta-carotene, alpha-tocopherol and other components. It contains the most deficient essential amino acids – lysine, tryptophan, histidine

in doses exceeding the physiological norm according to the FAO/WHO scale. The homogenate of drone brood contains 28 higher fatty acids, in particular such essential unsaturated acids as linoleic, linolenic and arachidonic [1, 2, 19]. The presence of a complex of the above-mentioned nutrients is one of the most important indicators, the potential of which can significantly affect the metabolic processes in the human body. If earlier drone brood was used as a therapeutic and prophylactic agent only empirically, relying only on the qualitative composition, today we approach the explanation of the mechanisms of biological action and on this basis the creation of new compositions using a biologically active product of a bee family [22].

The idea of biologically active fractions of propolis, flower pollen, honey has been theoretically generalized and experimentally developed and the possibility of their complex use in industrial production of medicines has been proved. For this purpose, methodological bases for the creation and production of apipreparations based on standardized substances of AP in the conditions of pharmaceutical enterprises have been developed [10]. A distinction should be made between *apiproductions* and *apipreparations*. The difference is that apipreparations have a different way of development and approval from apiproductions, they are considered a drug and are approved by the State Pharmacological Center of Ukraine. The path of apiproductions from development to implementation is much shorter. It is similar to special purpose foods.

Physicochemical properties of honey are well studied, in particular for liquid honey. However, the number of works on the physical properties of crystalline honey is insufficient. However, in the last two decades, a number of works appeared on the structural features of crystallized honey. It has been found, that each type of honey has its own specific shape of crystals. In rapeseed honey, among the evenly distributed small crystals, there are solitary large ones. In the case of crystallization of acacia honey, crystals of different size and geometric shape are detected, different outgrowths are formed on the crystals. Linden honey has sharp flat crystals. Much smaller structure has been found between the large crystals, the vertices of which end at acute angles. Buckwheat honey crystals are sharp and branched. Heather honey forms elongated crystals, and their length exceeds the width by 2–3 times. In recent years, scientists have found that as the temperature rises, the crystals begin to melt and the area, filled with liquid in the microscope field, increases and the area of the crystals decreases. At the same time, all crystals never disappear completely – new thermostable structures appear – fibrous crystals that look like twisted fibers or elongated columns. Such structures are not observed in native heated honeys [22].

According to the authors [15, 22], the crystals that remain after heating are the centers of crystallization and at thorough uniform mixing with various additives form fine crystalline mixtures, which are not further stratified. This makes it possible to substantiate the difference in the state of mixtures of apiphytocompositions, made using freshly pumped honey and crystallized one, obtained by heating, as a basis for liquid honey. These data make it possible to state that for the preparation of apiphytocompositions with a solid-phase apiphytocomponent it is necessary to use only crystallized honey. In our opinion, this phenomenon should be taken into account when creating new food recipes based on bee honey.

Scientific works [23–26] have established that the use of therapeutic and prophylactic agents is quite successful for the correction of pathological conditions based on the development of ionizing radiation, heavy metals, microorganisms and other toxicants. A special place among them is given to apiphytocompositions, which provide the body with a whole set of biologically active substances necessary for its vital functions, have a positive effect on the immune status, increasing the body's resistance to adverse environmental conditions. A characteristic feature of products, made from natural raw materials, is their safety, the absence of side effects and complications, the possibility of long-term use with high efficiency. It can be assumed, that the therapeutic effect of apiphytocompositions is due to their antioxidant activity, which contributes to the dysfunction of the mechanisms of nonspecific action, normalization of the system of lipid peroxidation and antioxidant protection of cell membranes of the organism.

At the same time, bees, as an object of wildlife, are exposed to negative environmental factors, which are reflected in the sanitary and hygienic assessment of the quality of AP. It should be noted, that the special influence on the sanitary and hygienic quality of the latter is exerted by

epizootic circumstances, in which bees are and carry out their vital activity. Pathogens of various infectious diseases, the circulation of one or another infectious process in a bee family in nature contributes to the contamination of bee products. In this case, the pathogen accumulates in the AP much earlier than the infectious disease is clinically manifested in the bee family. Pathogens that are harmful to humans can often get into AP, in particular honey, perga and flower pollen. Reports on apitherapy at the 35<sup>th</sup> Congress of Apimondia provided data on the isolation of pathogens, such as *Clostridia botulinus*, *Aspergillus fumigatus*, *Aspergillus flavus*, various species of *Salmonella*, *Escherichia Coli* and other enterobacteria, from honey. According to the literature, the ability of certain species of microorganisms pathogenic to bees and humans, in particular from the genera *Salmonella*, *Escherichia*, to survive in honey can reach up to 365 days [12, 27]. Therefore, honey (honeycomb or centrifuge), flower pollen, sold for the food and pharmaceutical industries, must undergo laboratory veterinary and sanitary control for the presence of pathogens of infectious human diseases.

## 6. Conclusions

The thorough analysis of the results of the scientific research convincingly testifies to the high biological value of AP.

1. Based on the study, the prospects for widespread use of AP in the development of special and dietary products, the use of which will contribute to the normalization of metabolic processes in pathological conditions and increase the resistance of the human body to stress of various origins, have been established.

2. The prospect of further research is a more detailed analysis of the use of AP in clinical conditions, scientific substantiation and creation of special health and therapeutic foods of high biological and functional value based on bee products.

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