ROYAL JELLY: A NATURAL COMPOUND FOR CARDIOVASCULAR SUPPORT AND ENVIRONMENTAL MINERAL BALANCE

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Annotation: Royal jelly is a natural compound with numerous therapeutic properties, including anti-inflammatory, antioxidant, and antithrombotic effects. It contains essential minerals like magnesium, potassium, copper, and zinc, vital for cardiovascular and immune function. Royal jelly may prevent platelet aggregation, helping reduce the risk of thrombosis. Mineral balance is crucial for resisting toxic exposure and maintaining health. The product's mineral profile reflects regional environmental conditions. Royal jelly is also valuable in ecological biomonitoring. Its high bioavailability and low toxicity make it a promising agent for health support.

Keywords: royal jelly, platelets, cardiovascular system, microelements, ecological monitoring, mineral balance, toxic elements, bioavailability.

Annotatsiya: Ona asal ari suti yurak-qon tomir tizimini qo'llab-quvvatlovchi tabiiy modda sifatida keng terapevtik xususiyatlarga ega. U tarkibida magniy, kaliy, mis va rux kabi muhim minerallarni saqlaydi. Bu moddalar qon aylanishi va immun tizimi faoliyatida muhim rol o'ynaydi. Asal ari ona suti trombotsitlar agregatsiyasini kamaytirishi mumkin, bu esa yurak xurujlari va insultlarning oldini olishda muhimdir. Mineral muvozanat sog'liq uchun hal qiluvchi ahamiyatga ega. Shuningdek, bu modda ekologik monitoring uchun indikator sifatida xizmat qilishi mumkin. Uning yuqori biologik faolligi va zararli ta'sirining yo'qligi uni muhim shifobaxsh manbaga aylantiradi.

Kalit so'zlar: ona asal ari suti, trombotsitlar, yurak-qon tomir tizimi, mikroelementlar, ekologik monitoring, mineral muvozanat, toksik elementlar, biouzluksiz o'zlashtirish.

Аннотация: Маточное молочко обладает множеством лечебных свойств, включая антиоксидантное, противовоспалительное и противотромботическое действие. Оно богато минеральными веществами, такими как магний, калий, медь и цинк, которые играют ключевую роль в здоровье сердечно-сосудистой системы. Баланс макро- и микроэлементов влияет на устойчивость организма к токсинам. Маточное молочко также может снижать агрегацию тромбоцитов, предотвращая образование тромбов. Изучение его состава важно для оценки экологического состояния региона.

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Это вещество имеет высокую биодоступность и минимальные побочные эффекты.

Ключевые слова: маточное молочко, тромбоциты, сердечно-сосудистая система, микроэлементы, экологический мониторинг, биодоступность, минералы, токсичные элементы.

Introduction

Cardiovascular diseases (CVDs) remain among the leading causes of morbidity and mortality worldwide. One of the key pathogenic mechanisms involved in these conditions is platelet hyperactivity, which plays a central role in thrombus formation, myocardial infarction, and ischemic stroke. The search for natural, safe, and effective agents capable of modulating platelet function and supporting vascular health has become increasingly relevant. In this context, royal jelly—a biologically active secretion of honeybees—has attracted scientific attention due to its multifaceted therapeutic properties, including anti-inflammatory, antioxidant, and potential antithrombotic effects. Additionally, the mineral composition of royal jelly offers another avenue for supporting cardiovascular and systemic health. Minerals such as magnesium, potassium, copper, and zinc are essential for metabolic regulation, enzymatic activity, and immune defense. However, modern environmental challenges such as mineral deficiencies, pollution, and toxic heavy metal accumulation have disrupted the natural mineral balance in both humans and animals. These imbalances not only weaken physiological resilience but also enhance the toxicity of harmful elements like lead and cadmium. This study investigates the potential of royal jelly as a natural compound that not only modulates platelet activity but also contributes to restoring mineral homeostasis. The novelty of the research lies in its dual approach: examining both the hemorheological effects and the mineral composition of royal jelly in the context of environmental and health challenges. The findings are expected to offer new insights into the development of natural therapies for cardiovascular support and ecological biomonitoring.

Platelets are a component of the blood cell population in mammals and play a significant role in determining the rheological properties of blood. Microrheological disorders of platelets are an important pathogenic factor in the development of many diseases [1,2].

An increase in the functional activity of platelets triggers the entire coagulation cascade, and platelets play a key role in the development of heart attacks and strokes. By acting on platelets, it is possible to prevent thrombus formation and slow the progression of ischemic heart diseases. Therefore, the search for effective and safe agents that influence vascular-platelet hemostasis remains a pressing issue [3,4].

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One such potential agent is royal jelly. It is known that royal jelly has a wide spectrum of therapeutic effects. It exhibits antiseptic, anti-inflammatory, astringent, analgesic, antioxidant properties; stimulates metabolism and tissue regeneration; supports beneficial intestinal flora; and activates hematopoiesis [5,6,7].

Moreover, there are reports that royal jelly has disaggregating effects (i.e., it prevents platelet aggregation) [5,7], although systematic studies in this direction have not been conducted.

A deficiency or excess of environmental minerals (macro- and microelements), their ratios, and compound forms equally affect the development of living organisms. In recent years, scientists have increasingly noted the impact of environmental mineral deficiencies, pollution, and heavy metal accumulation on human health [8,9,10].

As a modern scientific direction, identifying and evaluating changes in the levels of macro- and microelements in humans and animals plays an important role in understanding the causes and mechanisms of diseases. A stable chemical balance in the body is essential for its normal functioning. Environmental, climatic-geographical, and occupational factors can alter the levels of chemical elements in the human body, negatively impacting health.

The essential minerals for humans and animals include almost all elements from the Mendeleev Periodic Table. A deficiency or excess of any of these elements in the diet disrupts normal life processes and adaptive capabilities. Adaptation involves changes in metabolism and the exchange of biogenic elements, which can lead to imbalances in macro- and microelements and increase their biological demand.

Mineral deficiencies enhance the toxic effects of harmful elements such as mercury, lead, cadmium, arsenic, and nickel, which are widespread pollutants from industrial and agricultural activities [11,12,13].

Thus, restoring the mineral balance in living organisms is a critical issue. Academician V.I. Vernadsky was the first to demonstrate the role of macro- and microelements in the vital activities and biological processes of living organisms. According to his doctrine, chemical elements enter the organism through the soil-plant-animal-human system [14]. The mineral elements in the body must be maintained at optimal levels. Any imbalance reduces the body's resistance to harmful factors, decreases immune and antioxidant functions, and lowers quality of life.

Micro- and macroelements in the human body are selectively distributed, with their concentrations in organs and blood constantly changing. They are ingested through food and water. Beekeeping products, due to their complex

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chemical composition, can be a source of these elements. One such product is royal jelly, which is a complex mixture of proteins, fats, carbohydrates, vitamins, and minerals [15,16].

Approximately 3% of royal jelly's composition consists of mineral compounds. Its mineral content includes macroelements—potassium, calcium, magnesium, sodium—and microelements—copper, iron, zinc, manganese. It also contains trace amounts of gold, cobalt, nickel, silver, sulfur, and chromium.

This mineral diversity significantly enhances the biological value of royal jelly. Mineral compounds activate nearly all vitamins and enzymes in the body and participate in vital processes. Due to its high bioavailability and lack of side effects, the body does not expend much energy to absorb these nutrients [17].

Studies have examined the concentrations of certain macro- and microelements (such as magnesium, potassium, copper, zinc), as well as toxic pollutants (lead and cadmium) in royal jelly.

Based on their effects on living organisms, minerals can be divided into three groups: essential, indifferent, and toxic [18].

Magnesium (Mg) participates in protein, carbohydrate, and fat metabolism; it is crucial for the normal functioning of the nervous and cardiovascular systems, and it influences bone growth, flexibility, and strength. As a component of intracellular fluid, it affects plasma and bone phosphatases and serves as a cofactor for hundreds of enzymes, regulating membrane permeability [19].

Potassium (K) regulates cellular water balance, maintains acid-base balance, and is essential for protein and glycogen synthesis. It ensures nerve impulse transmission and participates in the function of cardiac and other muscle tissues. Potassium deficiency can lead to dehydration, heart arrhythmias, and muscle dysfunction (e.g., paralysis).

Copper (Cu) is involved in protein synthesis, hematopoiesis, and respiration. It plays a role in nerve impulse transmission, iron absorption, collagen production, and skin pigmentation. Copper is a component of many enzymes. A deficiency can cause low hemoglobin levels, dermatitis, and anemia [20,21,22].

Zinc (Zn) is the second most abundant essential microelement in the body after iron. It is involved in protein and nucleic acid synthesis, supports reproductive functions, and is essential for the synthesis of steroid, thyroid, and other hormones. Zinc deficiency leads to immune dysfunction, carbohydrate metabolism disorders, allergies, and skin conditions [23].

Optimal environmental concentrations, ratios, and compound forms of mineral elements are essential for the development of living organisms. Both deficiency and excess can negatively affect the health of plants, animals, and humans. Even trace amounts of non-essential minerals can harm both the

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environment and living organisms. Toxic elements include lead, mercury, cadmium, and arsenic.

Lead (Pb) accumulates in the human body throughout life. It damages blood-forming organs and the nervous system, disrupts endocrine gland metabolism, and impairs the digestive system.

Cadmium (Cd) enters the body through food and inhalation. It harms the respiratory system, liver, and kidneys, negatively affects the central nervous system, and disrupts phosphorus-calcium metabolism [23].

The accumulation of toxic elements in royal jelly is considered an integral indicator of anthropogenic pressure on environmental ecology and is used in apimonitoring.

The mineral composition of royal jelly largely depends on natural-climatic, geographical, anthropogenic factors, and the natural origin of the bees. Studying the macro- and microelement composition of royal jelly has fundamental scientific significance, as this product, being part of the bees' food chain, reflects the biogeochemical characteristics of the region in its chemical composition [23].

DISCUSSION AND RESULTS:

In conclusion, royal jelly demonstrates promising potential as a natural therapeutic agent for cardiovascular support and mineral balance restoration. Its rich composition of macro- and microelements—such as magnesium, potassium, copper, and zinc—plays a vital role in maintaining homeostasis and preventing disorders related to mineral deficiencies and toxic exposures. Furthermore, its anti-inflammatory, antioxidant, and antiplatelet properties offer a multifaceted approach to reducing the risk of thrombotic events, including heart attacks and strokes.

The mineral profile of royal jelly also reflects environmental conditions, making it a valuable bioindicator for ecological monitoring and public health assessment. Given its high bioavailability and low toxicity, royal jelly can be considered a safe supplementary agent for improving metabolic and cardiovascular health.

RECOMMENDATIONS

1. Further clinical and experimental studies should be conducted to confirm the antiplatelet effects of royal jelly in various populations.
2. Regular monitoring of royal jelly’s mineral content is recommended to ensure quality and environmental safety.
3. Royal jelly may be integrated into preventive strategies against cardiovascular diseases, particularly in regions with high exposure to environmental toxins.
4. Public awareness should be raised regarding the health benefits of beekeeping products, particularly in promoting natural, non-pharmacological approaches to health support.

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