DETERMINATION OF THE MACRO- AND MICROELEMENT CONTENT OF THE "PROPOLIS OIL" DIETARY SUPPLEMENT AND SUNFLOWER OIL

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At present, beekeeping is not only an important branch of agriculture but also a valuable source of raw materials for the pharmaceutical, cosmetic, and nutraceutical industries. Bee products exhibit a wide range of biological activities, including anti-inflammatory, immunostimulatory, antioxidant, and antiparasitic effects. In recent years, growing interest in natural therapeutic agents has led to renewed scientific attention toward bee-derived products and their potential applications in human health. One of the most prominent approaches is apitherapy, the use of bee products for therapeutic purposes, which is based on traditional medicinal practices. Today, apitherapy is widely recognized as a complementary and integrative medical approach. For centuries, bee products have been valued not only as nutritious foods but also as natural remedies and biologically active substances with diverse health-promoting properties. Among these products, bee venom and propolis have attracted considerable scientific interest because of their complex chemical composition and broad spectrum of biological activities. Bee venom contains several bioactive components, including melittin, apamin, and phospholipase A_2, which have demonstrated significant therapeutic potential. These compounds have been investigated for their anti-inflammatory, analgesic, antimicrobial, immunomodulatory, and anticancer properties. Consequently, bee venom has been explored as a potential therapeutic agent for the management of inflammatory disorders, chronic pain, autoimmune diseases, and other pathological conditions.

Propolis is another highly valuable bee product that plays a significant role in both conventional medicine and apitherapy. Owing to its rich content of flavonoids, phenolic acids, terpenoids, and other biologically active compounds, propolis possesses potent antioxidant, antimicrobial, anti-inflammatory, antiviral, and immunomodulatory activities. Its recognized therapeutic potential has promoted the development of numerous pharmaceutical formulations and natural health products containing propolis as an active ingredient. Furthermore, understanding the mechanisms by which honey bees collect and process propolis and honey provides valuable insights into their ecological importance. These activities contribute not only to colony defense and survival but also to plant pollination and ecosystem stability, emphasizing the essential role of honey bees in maintaining biodiversity and supporting sustainable agriculture. The macro- and microelement compositions of the “PROPOLIS OIL” dietary supplement and sunflower oil were determined using X-ray fluorescence (XRF) spectroscopy. As both samples were in liquid form, they were prepared for analysis by sealing the sample cups with Mylar film, ensuring the absence of air bubbles to obtain reliable analytical results. Elemental analysis was performed using an Epsilon4 XRF spectrometer equipped with Epsilon3 software and the Omnian standardless calibration system under a helium atmosphere with a flow rate of 0.61 L min^{-1}. The recorded spectra enabled the identification of individual elements based on their characteristic fluorescence peaks, while peak intensities were proportional to their relative concentrations. The macro- and microelement compositions of sunflower oil and “PROPOLIS OIL” were evaluated by XRF spectroscopy. The analytical results were expressed as the relative percentage of each detected element. Comparison of the two samples revealed significant differences in their elemental profiles. In particular, the concentrations of several trace elements were higher in “PROPOLIS OIL” than in the untreated sunflower oil.

The propolis extraction process resulted in increased relative concentrations of Na, Mg, Al, Si, K, Ca, and Fe in the enriched oil. Moreover, several elements, including Cu, Zn, Mn, Sr, and Ba, were detected exclusively in “PROPOLIS OIL”, whereas they were absent or present only at trace levels in the sunflower oil. These findings indicate the effective transfer of mineral constituents from propolis into the oil phase during the extraction process. The obtained results demonstrate that “PROPOLIS OIL” is enriched with essential macro- and microelements, which may contribute to its enhanced biological and pharmacological properties. Furthermore, the study confirms that X-ray fluorescence (XRF) spectroscopy is a rapid, reliable, and effective technique for

determining the elemental composition of edible oils and propolis-enriched oil formulations.

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