

Background: Bee products such as honey and propolis are frequently used as a traditional remedy since ancient times. Nowadays, interest in these products is increasing due to their numerous beneficial and health-promoting properties and, moreover, they are applied in alternative medicine and apitherapy. Nowadays, honey and propolis and their characteristics are very well known. Their properties include, for example, antioxidant, antimicrobial, antiviral, anti-inflammatory, antifungal, wound healing, and cardioprotective activity. Among the bee products, bee bread deserves attention due to its high nutritional values. Bee bread is a product of fermentation of bee-collected pollen and is the main source of proteins and lipids for bee larvae. The composition of bee bread is relatively known and it depends on botanical and geographic origin, climate, soil type, season and weather condition. Bee bread especially contains easily assimilated proteins like all human essential amino acids and polyunsaturated fatty acids, which are not synthesized in human body. Moreover, this product is a good source of minerals (e.g. potassium, phosphorus, zinc, magnesium, manganese, iron), and vitamins (B-complex vitamins and vitamin K), and polyphenols as well. However, there is a lack of knowledge about biological properties of this product, including its antiviral and cell-protective potential. Our previous research showed that bee bread exhibited significant antibacterial activity against human pathogens, including resistant strains of staphylococci. However, to date, there is very little information on the antiviral potential of this product. Furthermore, according to existing state of knowledge, bee bread reveals antitoxic activity against damages induced by aluminum and titanium nanoparticles on rats' cells and it shows antitumor potential against cancerous cells lines (e.g. Caco-2, PC3, HepG-2, MCF-7, H460, HeLa). Phenolic compounds that are known as excellent antioxidants can prevent tissue damage caused by free radicals by inhibiting the generation of radicals, scavenging them, or by promoting their decomposition. It is investigated that propolis exhibits genoprotective activity on rat cells due to presence of phenolic compounds. Bee bread contains a significant amount of polyphenols. The most abundant phenolic compounds in bee bread are flavonoids - naringenin, kaempferol, apigenin, isorhamnetin, quercetin, rutin, and myricetin and *p*-coumaric acid as phenolic acid.

Hypothesis: Bee bread components, mainly polyphenols, have a protective effect on human cells treated with free radicals, which can be involved in many chronic health problems, for example, cardiovascular diseases, inflammatory diseases, and cancer. Extracts of bee bread exhibits antiviral activity against Influenza A virus (A/H1N1).

Objective: The project aims to demonstrate the influence of bee bread chemical components on i) genotoxic/antigenotoxic and mutagenic/antimutagenic activity of bee bread extracts, and ii) an antiviral potential of bee bread samples derived from Polish apiaries.

Research plan: The research plan is divided into five stages: i) preparation of the collection of bee bread samples and preparation of extracts, ii) determination of chemical composition of bee bread samples, iii) evaluation of genotoxicity/antigenotoxicity of bee bread extracts on HEK-293 cell line, iv) evaluation of mutagenicity/antimutagenicity of bee bread extracts on HEK-293 cell line, and v) determination an antiviral activity of bee bread extracts against A/H1N1 virus.

Significance of the results: Investigating the antiviral and genoprotective/antimutagenic potential of bee bread is an innovative research. There are very few research groups working on this subject worldwide. The realization of the planned research will provide abundant information of high scientific value and will fulfil the gaps in the knowledge about the biological activity of bee bread.