СУЧАСНІ ДОСЯГНЕННЯ ФАРМАЦЕВТИЧНОЇ НАУКИ В СТВОРЕННІ ТА СТАНДАРТИЗАЦІЇ ЛІКАРСЬКИХ ЗАСОБІВ І ДІЄТИЧНИХ ДОБАВОК, ЩО МІСТЯТЬ КОМПОНЕНТИ ПРИРОДНОГО ПОХОДЖЕННЯ

Матеріали VIII Міжнародної науково-практичної інтернет-конференції

10 КВІТНЯ 2026

м. Харків

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SYNERGISTIC INTEGRATION OF ROYAL JELLY AND HERBAL COMPOUNDS IN MEDICAL COSMETICS

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Introduction. A significant transformation is occurring in the global skincare industry, with increasing emphasis on medical cosmetics products designed to integrate cosmetic appeal with pharmaceutical efficacy [1]. This transition is characterized by the use of bioactives derived from natural sources. Among beehive products, royal jelly is distinguished by its complex biochemical composition, that includes proteins, lipids, carbohydrates, and minerals specifically designed for the longevity and fertility of the honeybee queen [2].

Historically, royal jelly was utilized in traditional medicine for its rejuvenating properties. In modern dermatology, its value lies in its ability to modulate skin physiology at a molecular level. Simultaneously, herbal compounds such as those found in Panax ginseng, Camellia sinensis, have been extensively documented in the Chinese Journal of Natural Medicines for their anti inflammatory and antioxidant activities [3]. The integration of apitherapy and phytotherapy represents a comprehensive and integrative approach to skin health. By targeting multiple signaling pathways, these combined formulations provide a multifaceted defense against environmental stressors (UV radiation, pollution) and biological aging.

Royal jelly a nutrient dense secretion from the hypopharyngeal glands of worker bees (Apis mellifera), it represents a key component to its unique lipid profile specifically 10-hydroxy-2-decenoic acid (10-HDA) plus diverse proteome. When combined with bioactive herbal compounds such as polyphenols, flavonoids, and saponins, royal jelly exhibits enhanced bioavailability and enhanced efficacy.

Taking into consideration the biochemical mechanisms of royal jelly and herbal extracts in topical applications, the formulation focuses on collagen synthesis, tyrosinase inhibition (reducing skin pigmentation), and modulation of the Nrf2/Keap1 antioxidant pathway. Nrf2 (nuclear factor erythroid 2-related factor 2) is a

transcription factor that activates antioxidant and detoxifying genes, while Keap1 (Kelch-like ECH-associated protein 1) binds to Nrf2 under normal conditions and promotes its degradation, thereby keeping it inactive. Through this research, which includes a comparison with systematic reviews of recent clinical and in vitro studies, it is demonstrated that royal jelly herbal formulations significantly reduce markers of photoaging and accelerate dermal repair. The findings suggest that these combinations offer a potent natural alternative to synthetic compounds in the treatment of hyperpigmentation, dermatoses, and intrinsic skin aging.

Materials and methods. Fresh royal jelly was obtained from a controlled apiary and immediately stored at -20 °C to preserve its biological activity and prevent degradation of sensitive proteins and bioactive compounds. Prior to formulation, the royal jelly was thawed under controlled refrigeration conditions (4 °C) to maintain its physicochemical stability. Plant derived active ingredients were incorporated to enhance the functional properties of the formulation. Panax ginseng extract, standardized to 10 % ginsenosides, was procured from certified suppliers in China.

Results and their discussion. The prepared emulsion exhibited a homogeneous structure with a smooth texture and no visible phase separation immediately after preparation. The pH of the formulation remained within the range of approximately pH5.2-5.7, which is considered appropriate for dermatological and cosmetic products. Previous dermatological studies emphasize that formulations close to physiological skin pH minimize irritation and support normal epidermal function. The viscosity and consistency of the emulsion were suitable for topical application, forming a semisolid cream that spread easily across the skin surface. The biochemical mechanism underlying the ant aging effect of royal jelly centers on 10-hydroxy-2-decenoic acid (10-HAD). Our results showed a 35% increase in Type I collagen synthesis in human dermal fibroblasts cells treated with extract compared to the control. Mechanism, 10-HDA acts as a fatty acid that stimulates the transforming growth factor beta 1 (TGF-β1) signaling pathway. TGF-β1 binds to its receptors (TβRI and TβRII), inducing the phosphorylation of Smad2 and Smad3 proteins. These proteins form a complex with Smad4, which translocates into the nucleus to activate the transcription of the COL1A1 and COL1A2 genes, responsible for procollagen production [4].

The research suggests that while royal jelly is excellent for collagen stimulation, its efficacy is enhanced by herbal bioactive's ability to promote angiogenesis and fibroblast proliferation. Furthermore, the ginsenosides from ginseng improve the permeability of the skin barrier, allowing for deeper penetration of the 10-HDA and major royal jelly proteins. This multitargeted approach addressing transcription, enzymatic degradation, and structural integrity demonstrates why combined formulations are superior in medical cosmetics.

Conclusion. The practical application of royal jelly and selected herbal compounds in a cosmetic formulation demonstrates significant potential for medical grade skin care. The study confirms that, royal jelly's 10-HDA is a potent biochemical trigger for the TGF-β/Smad collagen synthesis pathway. The inclusion of Panax ginseng and herbal extracts produce a synergistic "shield" against collagen degradation by inhibiting Matrix Metalloproteinase-1 (MMP-1) expression. The

formulation maintained stability and bioactivity through cold emulsification techniques, making it a viable candidate for professional dermaceuticals. These results validate the use of herbal-apitherapeutics in modern medical cosmetics, moving beyond traditional practices toward evidence-based biochemical therapy.

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DETERMINATION OF PHENOLIC COMPOUNDS IN BROADLEAF PLANTAIN (*PLANTAGO MAJOR* L.) HERB AND LEAF SAMPLES COLLECTED FROM DIFFERENT REGIONS OF LITHUANIA

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Introduction. Broadleaf plantain (*Plantago major* L.) is a perennial medicinal plant known for its diverse therapeutic effects, which are mainly associated with its anti-inflammatory and antioxidant properties [1]. Previous studies have shown that the aerial parts of *Plantago major* contain phenolic compounds, including flavonoids and phenolic acids, which are involved in growth regulation processes and play an important role in defense mechanisms [2, 3]. The content of these compounds may vary depending on factors such as the development stage of the plant, the plant organ, climatic conditions, soil characteristics, and exposure to stress. It has been found that plants experiencing biotic or abiotic stress may accumulate higher levels of bioactive compounds as a defense response to adverse environmental conditions and pathogens [4, 5]. The aim of this study was to assess the distribution of phenolic compounds in leaf and herb samples of *Plantago major* collected from different regions of Lithuania.

Materials and methods. *Plantago major* leaves and herb were collected from five different regions of Lithuania between May and July 2024. The collected plant material was dried at room temperature (18-22 °C) in a well-ventilated area protected from direct sunlight and stored in paper bags in a dry, dark place. Total phenolic content was determined spectrophotometrically using the Folin-Ciocalteu reagent and expressed as mg GAE/g dry matter. The results were analyzed using MS Excel 2026 (Microsoft, USA) and IBM SPSS Statistics 31.0 (IBM, USA). All spectrophotometric analyses were performed in triplicate ($n = 3$) for each sample, and the results are expressed as mean ± SD. Group differences were assessed by one-way ANOVA followed by Tukey's post hoc test; $p < 0.05$ was considered statistically significant.