

Creation of cosmeceutical hydrogel mask with plant extract

Ya.I. Holubovska¹, R.O. Petrina², I.R. Buchkevych³, M.S. Kurka⁴

1. Department of Technology of Biologically Active Substances, Pharmacy and *Biotechnology*, Lviv Polytechnic National University, Ukraine, Lviv, S. Bandera Str., 12, E-mail: yana.holubovska.mnbtm.2022@lpnu.ua
2. Department of Technology of Biologically Active Substances, Pharmacy and *Biotechnology*, Lviv Polytechnic National University, Ukraine, Lviv, S. Bandera Str., 12, E-mail: romanna.o.petrina@lpnu.ua
3. Department of Technology of Biologically Active Substances, Pharmacy and *Biotechnology*, Lviv Polytechnic National University, Ukraine, Lviv, S. Bandera Str., 12, E-mail: iryana.r.buchkevych@lpnu.ua
4. Department of Technology of Biologically Active Substances, Pharmacy and *Biotechnology*, Lviv Polytechnic National University, Ukraine, Lviv, S. Bandera Str., 12, E-mail: mariia.s.kurka@lpnu.ua

Abstract – *In this work we have studied the features of hydrogel-Calendula officinalis extract complexes creation based on synthetic HEMA:PVP hydrogel and natural hydrogel with hyaluronic acid. The sorption properties of hydrogel carriers were studied and it was established that the created complexes contain flavonoids, exhibit antioxidant and antimicrobial effects. As a result, after conducting a number of necessary studies, there are high prospects for the use of these hydrogel complexes for the creation of cosmetic masks.*

Keywords - hydrogel, extract, polyvinylpyrrolidone (PVP), 2-hydroxyethyl methacrylate (HEMA), hyaluronic acid (HA), *Calendula officinalis*.

Introduction

Skin is the largest organ of the body, since it provides a physical and chemical barrier and protects the body from various types of environmental influence. Its condition is essential, that is why today, the development of care cosmetics is a promising and relevant topic. In cosmetic preparation, several raw materials are used. Formulating is a combination of art and science and relies on the knowledge of general, physical, inorganic and organic, polymer as well as raw materials chemistry. Among them, synthetic polymers and biopolymers are extensively used. Many natural polymers play a significant role in cosmetic formulation as moisturizers agents. Based on biopolymers and synthetic polymers, a range of hydrogels can be formed for potential cosmetic and biomedical applications.

The purpose of the study is to obtain hydrogel materials and create hydrogel-extract *Calendula officinalis* complexes for the development of hydrogel cosmeceutical masks.

Hydrogels for cosmeceutical masks must meet a number of requirements, including: high strength, elasticity and shape stability, the ability to swell in alcohol solutions and water, and the material must be non-toxic and non-allergenic.

We have carried out the studies and obtained a hydrogel matrix by free-radical polymerization under the action of the initiator - potassium persulfate. The hydrogel is formed by two monomeric blocks of HEMA and PVP and contains functional groups: hydroxyl and carbonyl (HEMA) and amide (PVP). The sorption capacity depends on the amount of these groups and also on the porosity of hydrogel. Sorption capacity is very important because it determines the amount of extract with which we saturate the hydrogel. The received results of the synthesized hydrogels indicate high sorption capacity, elasticity, shape stability in water/solvents and biotolerance. Such characteristics provide the possibility to saturate the copolymers of HEMA & PVP (pHEMA-pr-PVP) with healing plants extracts.

The hydrogel-extract *Calendula officinalis* complexes has been created and opportunity of its use for prolonged enrichment of the skin with biologically active components and for application in irritations, inflammation or certain skin diseases has been established [1].

Among natural hydrogels, hydrogel based on hyaluronic acid is promising. Hyaluronic acid (HA) has gained significant widespread usage by the cosmetic industry. HA has favourable properties

due to its biocompatibility, non-immunogenicity, and biodegradability. Hyaluronic acid (HA) hydrogels, obtained by cross-linking HA molecules with cross-linking agents based on a simple, reproducible, and safe process that does not employ any organic solvents were developed [2].

These hydrogels show excellent properties suitable for hydrogel-extract complexes creation that would increase the elasticity of the skin, provide hydration and have anti-inflammatory properties.

The key factor of the research is the sorption properties of the hydrogel mask and the environmental friendliness of the complex, due to the choice of active ingredients and materials. Therefore, *Calendula officinalis* extract was chosen. Bioactive compounds are present in different plants extracts and exhibit biological activity. For example, the leaves of *Calendula officinalis* contain triterpenoid esters, flavoxanthin, auroxanthin, carotenoids (lutein, zeaxanthin, beta-carotene). The flowers of *Calendula officinalis* contain flavonol glycosides, triterpene oligoglycosides, oleanane-type triterpene glycosides, saponins, and a sesquiterpene glucoside. Plant extracts are also widely used in cosmetics, presumably due to the presence of such compounds as flavonoids, saponins, resins, and essential oils. Plant pharmacological studies have suggested that *Calendula* extracts may have anti-viral, anti-genotoxic, and anti-inflammatory, anti-bacterial and fungicidal properties. That's why there is a possibility to saturate the hydrogels with *Calendula officinalis* extracts and to receive biologically active materials, which can be used in cosmeceutical to design cosmetic masks with antibacterial and antioxidant properties for application in irritations, inflammation or certain skin diseases [3].

Conclusions

Consequently, created hydrogel materials with *Calendula* extract fully meet the requirements for hydrogel carriers in terms of physical and chemical properties and contain biologically active substances. The results indicate that such complexes can be used for the development of hydrogel cosmetic masks with moisturizing, antibacterial and antioxidant properties for application in irritations, inflammation or certain skin diseases.

References

- [1] Fatimah Rashid, & Mustafa Albayati, & Kalliopi Dodou (2022). Novel Crosslinked HA Hydrogel Films for the Immediate Release of Active Ingredients. *Cosmetics*, 2022, 10 (6), 1-18. DOI: <https://doi.org/10.3390/cosmetics10010006>
- [2] R.O. Petrina, & M.S. Kurka, & Ya.I. Holubovska, & S.A. Suberlyak, & O.V. Fedorova, & O.M. Hrytsenko (2022). Research of complex of calendula officinalis extract–hydrogel for application in cosmeceuticals. *Voprosy khimii i khimicheskoi tekhnologii*, 2022, 3, 53-59. DOI: [10.32434/0321-4095-2022-142-3-53-59](https://doi.org/10.32434/0321-4095-2022-142-3-53-59)
- [3] Disha Arora, & Anita Rani, & Anupam Sharma (2013). A review on phytochemistry and ethnopharmacological aspects of genus *Calendula*. *Pharmacognosy Reviews*, 2013, 7 (14), 179-187. DOI: <http://dx.doi.org/10.4103/0973-7847.120520>