

RAZVOJ I KARAKTERIZACIJA MUKOADHEZIVNIH BUKALNIH FILMOVA SA PROPILENGLIKOLNIM EKSTRAKTOM PROPOLISA

Ivana Kurćubić^{1*}, Jelena Mudrić², Jelena Đuriš¹

¹Katedra za farmaceutsku tehnologiju i kozmetologiju, Univerzitet u Beogradu -
Farmaceutski fakultet, Beograd, Srbija

²Institut za proučavanje lekovitog bilja „Dr Josif Pančić“, Beograd, Srbija

*ivana.kurcubic@pharmacy.bg.ac.rs

Propolis, poznat kao „pčelinji lepak“, predstavlja prirodni proizvod bogat flavonoidima i fenolnim kiselinama, sa dokazanim antioksidativnim, antimikrobnim i antiinflamatornim delovanjem [1]. Zahvaljujući tim osobinama, ekstrakt propolisa se široko primenjuje u prevenciji i lečenju infekcija usne duplje i ždrela, posebno oralne kandidijaze, gingivitisa i parodontalnih bolesti, kao i u jačanju imunog sistema [2]. Bukalni film je savremen farmaceutski oblik koji omogućava laku primenu, fleksibilno doziranje i potencijalno lokalno i sistemsko delovanje [3]. Cilj ovog istraživanja bio je razvoj i karakterizacija inovativnih mukoadhezivnih bukalnih filmova sa propilenglikolnim ekstraktom propolisa, primenom polietilenoksida (PEO), polivinil alkohola (PVA), eritritola i stevije. Filmovi sa 10% ekstrakta propolisa pripremljeni su metodom izlivanja, korišćenjem PEO različitih molekulskih masa (2×10^5 – 1×10^6 Da) u koncentracijama 3 i 3,5%, uz PVA (1,5%), eritritol (3%) i tečnu steviju (1%). Od osam formulacija, pet je zadovoljilo organoleptičke kriterijume i dalje je ispitano u pogledu homogenosti, mehaničkih i mukoadhezivnih svojstava, brzine i mehanizma oslobađanja ukupnih flavonoida. Povećanje molekulske mase i koncentracije PEO značajno je uticalo na homogenost, čvrstoću, elastičnost, mukoadheziju i brzinu oslobađanja katehina. Formulacija F8 (3,5% PEO 1×10^6 Da) pokazala je najpoželjnija svojstva u pogledu mehaničke čvrstoće ($1,88 \pm 0,28$ MPa), elastičnosti ($424,57 \pm 142,78\%$), mukoadhezije ($F_{\max}=2,22 \pm 0,19$ N; $W_{ad}=16,71 \pm 4,92$ mJ) i brzine oslobađanja katehina (80% za 30 min) koja prati kinetiku prvog reda ($R^2=0,9381$). Razvijeni mukoadhezivni bukalni filmovi sa propolisom mogu se smatrati savremenim farmaceutskim oblikom koji može da obezbedi lokalni terapijski efekat istovremeno pružajući mogućnost sistemske apsorpcije bioaktivnih supstanci.

Literatura

1. Kocot J, Kielczykowska M, Luchowska-Kocot D, Kurzepa J, Musik I. Antioxidant potential of propolis, bee pollen, and royal jelly: Possible medical application. *Oxidative Medicine and Cellular Longevity* 2018; 2018:7074209.
2. Etebarian A, Alhouei B, Mohammadi-Nasrabadi F, Esfarjani F. Propolis as a functional food and promising agent for oral health and microbiota balance: A review study. *Food Science & Nutrition* 2024; 12(8):5329–5340.
3. Shipp L, Liu F, Kerai-Varsani L, Okwuosa TC. Buccal films: A review of therapeutic opportunities, formulations & relevant evaluation approaches. *Journal of Controlled Release* 2022; 352:1071-1092.

Zahvalnica

Autori bi želeli da se zahvale Aleksandri Stefanović, studentkinji integrisanih akademskih studija na Farmaceutskom fakultetu Univerziteta u Beogradu na pomoći u eksperimentalnom radu.

DEVELOPMENT AND CHARACTERIZATION OF MUCOADHESIVE BUCCAL FILMS WITH PROPYLENE GLYCOL EXTRACT OF PROPOLIS

Ivana Kurćubić^{1*}, Jelena Mudrić², Jelena Đuriš¹

¹Department of Pharmaceutical Technology and Cosmetology, University of Belgrade - Faculty
of Pharmacy, Belgrade, Serbia

²Institute for Medicinal Plants Research "Dr. Josif Pančić", Belgrade, Serbia

*ivana.kurcubic@pharmacy.bg.ac.rs

Propolis, or "bee glue", is a natural product rich in flavonoids and phenolic acids, recognized for its antioxidant, antimicrobial, and anti-inflammatory properties [1]. It is widely used in the prevention and treatment of oral and pharyngeal infections, particularly oral candidiasis, gingivitis, and periodontal diseases, as well as in supporting the immune system [2]. Buccal film represents a modern dosage form with several advantages, including easy administration, dose flexibility, suitability for pediatric, elderly and dysphagic patients, and the potential for both local and systemic effects [3]. This study aimed to develop and characterize mucoadhesive buccal films containing propylene glycol extract of propolis, using polyethylene oxide (PEO), polyvinyl alcohol (PVA), erythritol, and liquid stevia. Films with 10% propolis extract were prepared by solvent casting, combining PEO of different molecular weights (3×10^5 – 1×10^6 Da) at 3–3.5% with PVA (1.5%), erythritol (3%), and stevia (1%). Out of eight formulations, five met organoleptic criteria and were further evaluated for mass uniformity, mechanical and mucoadhesive properties, rate and mechanism of total flavonoid release. Increasing PEO molecular weight and concentration significantly affected film homogeneity, strength, elasticity, mucoadhesion, and catechin release rate. Formulation F8 (3.5% PEO, 1×10^6 Da) showed the most favorable profile, with mechanical strength of 1.88 ± 0.28 MPa, elasticity of $424.57 \pm 142.78\%$, mucoadhesion ($F_{\max} = 2.22 \pm 0.19$ N; $W_{ad} = 16.71 \pm 0.492$ mJ), and catechin release of 80% within 30 min, following first-order kinetics ($R^2 = 0.9381$). The developed mucoadhesive buccal films with propolis extract represent an innovative dosage form capable of providing local therapeutic effect with the possibility of systemic absorption of bioactive compounds.

References

1. Kocot J, Kielczykowska M, Luchowska-Kocot D, Kurzepa J, Musik I. Antioxidant potential of propolis, bee pollen, and royal jelly: Possible medical application. *Oxidative Medicine and Cellular Longevity* 2018; 2018: 7074209.
2. Etebarian A, Alhouei B, Mohammadi-Nasrabadi F, Esfarjani F. Propolis as a functional food and promising agent for oral health and microbiota balance: A review study. *Food Science & Nutrition* 2024; 12(8): 5329–5340.
3. Shipp L, Liu F, Kerai-Varsani L, Okwuosa TC. Buccal films: A review of therapeutic opportunities, formulations & relevant evaluation approaches. *Journal of Controlled Release* 2022; 352:1071-1092.

Acknowledgements

This work was funded by the Ministry of Science, Technological Development and Innovation of the Republic of Serbia, 46013.