PHYSICOCHEMICAL CHARACTERIZATION OF THE FORMATION OF CHITOSAN/XANTHAN GUM-BASED POLYELECTROLYTE COMPLEXES AS IBUPROFEN CARRIERS

Ana Ćirić[1*], Ljiljana Đekić[1]

[1]University of Belgrade – Faculty of Pharmacy, Department of Pharmaceutical Technology and Cosmetology, Belgrade, Serbia

*ana.ciric@pharmacy.bg.ac.rs

By mixing the dispersions of oppositely charged polymers, intermolecular interactions are established and polyelectrolyte complexes (PECs) are formed. These interactions can differ in strength and extent, which can be influenced by the presence of the drug in the complex (1). The aim of this study was the physicochemical characterization of the formation of chitosan (CH)/xanthan gum (XG)-based placebo and ibuprofen-loaded PEC. The course of the PECs formation process was monitored by measuring the transmittance, which was reduced by adding XG dispersion, without or with ibuprofen, into CH dispersion whose initial transmittance was 97.53±0.64%. The final transmittance was 11.51±2.98% for placebo and 0.29±0.10% for ibuprofen-loaded PEC. The decrease in transmittance indicated the formation of complexes by establishing interactions between polymers and ibuprofen. CH dispersion had a Newtonian type of flow, while XG dispersions without and with ibuprofen and PEC hydrogels had pseudoplastic flow with thixotropy. The maximum apparent viscosities (η_{max} at 22.2 s^{-1}) of PEC hydrogels (1.65±0.06 Pa·s for placebo and 2.18±0.04 Pa·s for ibuprofen-loaded PEC) were higher compared to the dynamic viscosity of CH dispersion (0.09±0.01 Pa·s) and η_{max} of XG dispersion without (0.20±0.00 Pa·s) and with ibuprofen (0.22±0.00 Pa·s). The measured increase of maximum apparent viscosities in PEC hydrogels confirmed the formation of complexes. Higher apparent viscosities corresponded to stronger interactions within PECs (2). Interactions were stronger in ibuprofen-loaded compared to placebo PEC, so it can be assumed that the ibuprofen entrapment can result in its controlled release from the carrier.

References

1. Luo Y, Wang Q. Recent development of chitosan-based polyelectrolyte complexes with natural polysaccharides for drug delivery. Int J Biol Macromol 2014; 64:353–67.
2. Ćirić A, Medarević Đ, Čalija B, Dobričić V, Rmandić M, Barudžija T, Malenović A, Djekic L. Effect of ibuprofen entrapment procedure on physicochemical and controlled drug release performances of chitosan/xanthan gum polyelectrolyte complexes. Int J Biol Macromol 2021; 167:547–58.

Acknowledgements

This research was funded by the Ministry of Education, Science and Technological Development, Republic of Serbia through Grant Agreement with University of Belgrade – Faculty of Pharmacy No: 451-03-68/2022-14/200161.

FIZIČKO-HEMIJSKA KARAKTERIZACIJA FORMIRANJA POLIELEKTROLITNIH KOMPLEKSA HITOZAN/KSANTAN GUMA KAO NOSAČA IBUPROFENA

Ana Ćirić[1*], Ljiljana Đekić[1]

[1]Univerzitet u Beogradu – Farmaceutski fakultet, Katedra za farmaceutsku tehnologiju i kozmetologiju, Beograd, Srbija

*ana.ciric@pharmacy.bg.ac.rs

Mešanjem disperzija suprotno naelektrisanih polimera dolazi do uspostavljanja međumolekulskih interakcija i formiranja polielektrolitnih kompleksa (PEK). Ove interakcije mogu biti različite jačine i obima, na šta može uticati i prisustvo lekovite supstance u kompleksu (1). Cilj ovog istraživanja bila je fizičko-hemijska karakterizacija formiranja placebo i PEK sa ibuprofenom na bazi hitozana (H) i ksantan gume (KG). Tok procesa formiranja PEK praćen je merenjem transmitance, koja se smanjivala dodavanjem disperzije KG, sa ili bez ibuprofena, u disperziju H čija je inicijalna transmitanca bila 97,53±0,64%. Kod placebo PEK finalna transmitanca bila je 11,51±2,98%, a kod PEK sa ibuprofenom 0,29±0,10%. Smanjenje transmitance ukazalo je na očekivano formiranje kompleksa uspostavljanjem interakcija između polimera i ibuprofena. Disperzija H imala je njutnovski tip proticanja, a disperzije KG sa i bez ibuprofena i PEK hidrogelovi, pseudoplastično proticanje sa tiksotropijom. Maksimalni prividni viskoziteti (η_{max} na 22,2 s^{-1}) PEK hidrogelova bili su 1,65±0,06 Pa·s (placebo PEK) i 2,18±0,04 Pa·s (PEK sa ibuprofenom), što je bilo veće u poređenju sa dinamičkim viskozitetom disperzije H (0,09±0,01 Pa·s) i η_{max} disperzije KG bez (0,20±0,00 Pa·s) i sa ibuprofenom (0,22±0,00 Pa·s). Izmereni porast maksimalnog prividnog viskoziteta u PEK hidrogelovima potvrdio je formiranje PEK i uspostavljanje karakterističnih interakcija između njegovih komponenata. Veći prividni viskoziteti odgovarali su jačim i obimnijim interakcijama unutar PEK (2). Interakcije su bile jače u PEK sa ibuprofenom u odnosu na placebo PEK, pa se može pretpostaviti da bi se inkorporiranjem ibuprofena u PEK moglo postići njegovo kontrolisano oslobađanje iz nosača.

Literatura

1. Luo Y, Wang Q. Recent development of chitosan-based polyelectrolyte complexes with natural polysaccharides for drug delivery. Int J Biol Macromol 2014; 64:353–67.
2. Ćirić A, Medarević Đ, Čalija B, Dobričić V, Rmandić M, Barudžija T, Malenović A, Djekic L. Effect of ibuprofen entrapment procedure on physicochemical and controlled drug release performances of chitosan/xanthan gum polyelectrolyte complexes. Int J Biol Macromol 2021; 167:547–58.

Zahvalnica

Ovo istraživanje finansirano je od strane Ministarstva prosvete, nauke i tehnološkog razvoja Republike Srbije kroz Ugovor sa Univerzitetom u Beogradu – Farmaceutskim fakultetom broj: 451-03-68/2022-14/200161.