Comparison of Polymerization Techniques for the Development of Molecularly Imprinted Polymer-Based Electrochemical Sensor Used for Anticancer Drug Determination

S. Irem KAYA[1]
Mahsa Majidian[2], Goksu Ozcelikay[2], Ahmet Cetinkaya[2,3], Burcu Dogan Topal[2], Esen Bellur Atici[4], Sibel A. Ozkan[2]
[1]*University of Health Sciences, Gulhane Faculty of Pharmacy, Analytical Chemistry Department, Ankara, Türkiye*
[2]*Ankara University, Faculty of Pharmacy, Analytical Chemistry Department, Ankara, Türkiye*
[3]*Ankara University, Graduate School of Health Sciences, Ankara, Türkiye*
[4]*DEVA Holding A.S., R&D Center, Tekirdağ, Türkiye*
ikaya19.07@hotmail.com

Olaparib (OLA; 1-(Cyclopropylcarbonyl)-4-[5-[(3,4-dihydro-4-oxo-1-phthalazinyl)methyl]-2-fluorobenzoyl]piperazine), a significant anticancer drug, is used for the treatment of ovarian, prostate, breast, and pancreatic cancers. The mechanism of action of OLA is described as the inhibition of poly(ADP-ribose) polymerase (PARP) [1,2]. This study describes the first molecularly imprinted polymer (MIP)-based electrochemical sensor used for the determination of OLA. This sensor combines the high sensitivity, cheapness, and easy-use advantages of electrochemical sensors with the superior selectivity of MIPs. Because lack of selectivity can be a major issue in electrochemical sensors, MIPs have specific recognition ability thanks to the functional monomer and template-assisted polymerization process. In this work, two different polymerization techniques, photopolymerization (PP) and thermal polymerization (TP), were utilized. For both techniques same functional monomer, 4-aminobenzoic acid (4-ABA), was used with other necessary constituents such as ethylene glycol dimethacrylate (EGDMA), 2-hydroxy-2-methylpropiophenone, sodium dodecyl sulfate (SDS), tetraethyl orthosilicate (TEOS), etc. While UV light was used in the PP process, an oven was used to reach the desired temperature in TP. The surfaces of both developed sensors were characterized electrochemically and morphologically. In electrochemical measurements performed with MIP-based sensors, the indirect method was preferred, and a solution of 5 mM $[Fe(CN)_6]^{3-/4-}$ was used as the redox probe. The linear working range for both sensors was determined between 0.1 and 1 nM for the standard solution and the commercial human serum sample. The LOD values for the standard solution for PP and TP methods were found as 4.2 pM and 28.6 pM, respectively. Good recovery and RSD% values as a result of serum and tablet applications were obtained, and the sensors' accuracy was confirmed. Interference and imprinting factor studies demonstrated high selectivity. Finally, the non-imprinted polymer (NIP) was used to check MIP-based sensors' performance.

References

[1] D. Kavitapu et al., New Rapid Stability indicating RP-UPLC Method for the Determination of Olaparib, its Related Substances and Degradation Products in Bulk drug and Dosage Form, Materials Today: Proceedings, 14 (2019) 492–503.
[2] E. D. Deeks, Olaparib: First Global Approval, Drugs, 75 (2015) 231–240