Copper Oxide Based Disposable Sensors for Sensitive Voltammetric Assay of Sumatriptan

Afrah M. Aldawsari^{1,2}, Mohamed E. Khalifa³, Alaa M. Munshi¹, Reem Shah¹, Ali A. Keshk⁴, Fawaz Saad¹, Nashwa M. El-Metwaly^{1,5,*}

¹ Department of Chemistry, Faculty of applied science, Umm-Al-Qura University, Makkah, Saudi-Arabia

² Petrochemical Research institute, King Abdulaziz City for Science and Technology, P.O. Box 6086, Riyadh 11442, Saudi Arabia

³ Department of Chemistry, College of Science, Taif University, P.O. Box 11099, Taif 21944, Saudi Arabia

⁴ Department of Chemistry, College of Science, University of Tabuk, Saudi Arabia

⁵ Department of Chemistry, Faculty of Science, Mansoura University, El-Gomhoria Street, Egypt

*E-mail: n_elmetwaly00@yahoo.com

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Sumatriptan (SUM) is a member of the triptan family that is widely applied for the treatment of cluster headache attacks and migraines. Herein, novel disposable screen-printed sensors (SPS) were incorporated in situ with copper oxide nanoparticles (CuO) and utilized for differential pulse voltammetric determination of the submicromolar concentration of sumatriptan in pharmaceutical formulations and biological fluids. Modification with copper oxide nanoparticles enhanced both the peak height and electroactive surface area which in turn improved the sensitivity towards SUM compared with the blank electrode. At the optimum measuring parameters, the peak heights were linearly proportional to the SUM concentration ranged from 0.33 to 3.54 $\mu\text{mol L}^{-1}$ ($I_p = 0.067 + 0.132 \text{ SUM } [\mu\text{mol L}^{-1}]$, $r = 0.9996$) with a detection limit ($3.3 \sigma/S$) 0.066 $\mu\text{mol L}^{-1}$. The fabricated sensor showed high sensitivity, fabrication reproducibility and prolonged operational lifetime. The CuO/SPE exhibits improved resolution effect between the sumatriptan voltammetric peaks and those for uric acid, ascorbic acid and paracetamol offering a simple simultaneous determination of sumatriptan in the clinical and pharmaceutical formulations in presence of interferents. The applicability of the fabricated modified electrodes was demonstrated by assaying of sumatriptan with sensitivity and selectivity in agreement with the pharmacopial methods. The oxidation of sumatriptan on the electrode surface was studied electrochemically and the proposed mechanism was illustrated with the aid of molecular orbital calculations.

Keywords: Sumatriptan; Disposable screen printed sensors; Copper oxide nanoparticles; Differential pulse voltammetry; Molecular orbital calculations.

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