

EVALUATION OF CARBON PASTE ELECTRODE MODIFIED WITH HEAVY METALS FOR THE ANALYSIS OF PARACETAMOL BY VOLTAMMETRY AND IMPEDANCE SPECTROSCOPY

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References:

1. Goyal, R.N.; Gupta, V.K.; Oyama, M.; et al. Differential pulse voltammetric determination of paracetamol at nanogold modified indium tin oxide electrode. *Electrochem. Commun.* **2003**, 7 (8), 803-807.
2. Tjølsen, A.; Lund, A.; Hole, K. Antinociceptive effect of paracetamol in rats is partly dependent on spinal serotonergic systems. *Eur. J. Pharmacol.* **1991**, 193 (2), 193-201.
3. Bianchi, M.; Panerai, A.E. The dose-related effects of paracetamol on hyperalgesia and nociception in the rat. *Brit. J. Pharmacol.* **1996**, 117 (1), 130-132.
4. Yin, H.; Shang, K.; Meng, X.; et al. Voltammetric sensing of paracetamol, dopamine and 4-aminophenol at a glassy carbon electrode coated with gold nanoparticles and an organophilic layered double hydroxide. *Microchim. Acta.* **2011**, 175 (1-2), 39-46.
5. Björkman, R.; Hallman, K.M.; Hedner, J.; et al. Acetaminophen blocks spinal hyperalgesia induced by NMDA and substance P. *Pain.* **1994**, 57 (3), 259-264.
6. Hunskaar, S.; Fasmer, O.B.; Hole, K. Acetylsalicylic acid, paracetamol and morphine inhibit behavioral responses to intrathecally administered substance P or capsaicin. *Life Sci.* **1985**, 37 (19), 1835-1841.
7. Carlsson, K.H.; Jurna, I. Central analgesic effect of paracetamol manifested by depression of nociceptive activity in thalamic neurones of the rat. *Neurosci. Lett.* **1987**, 77 (3), 339-343.
8. Ross, R.K.; McCurtis, J.W.; Henderson, B.E.; et al. Descriptive epidemiology of testicular and prostatic cancer in Los Angeles. *Brit. J. Canc.* **1979**, 39 (3), 284-292.
9. Goyal, R.N.; Gupta, V.K.; Chatterjee, S. Voltammetric biosensors for the determination of paracetamol at carbon nanotube modified pyrolytic graphite electrode. *Sens. Actuators. B Chem.* **2010**, 149 (1), 252-258.
10. Srivastava, M.K.; Ahmad, S.; Singh, D. et al. Titrimetric determination of dipyrone and paracetamol with potassium hexacyanoferrate (III) in an acidic medium. *Analyst.* **1985**, 110 (6), 735-737.
11. Cañada, M.A.; Reguera, M.P.; Medina, A.R.; et al. Fast determination of paracetamol by using a very simple photometric flow-through sensing device. *J. Pharm. Biomed. Anal.* **2000**, 22 (1), 59-66.
12. Vilchez, J.; Blanc, R.; Avidad, R.; et al. Spectrofluorimetric determination of paracetamol in pharmaceuticals and biological fluids. *J. Pharm. Biomed. Anal.* **1995**, 13 (9), 1119-1125.
13. Lau, O.W.; Luk, S.F.; Cheung, Y.M. Simultaneous determination of ascorbic acid, caffeine and paracetamol in drug formulations by differential-pulse voltammetry using a glassy carbon electrode. *Analyst.* **1989**, 114 (9), 1047-1051.
14. Ravisankar, S.; Vasudevan, M.; Gandhimathi, M.; et al. Reversed-phase HPLC method for the estimation of acetaminophen, ibuprofen and chlorzoxazone in formulations. *Talanta.* **1989**, 46 (6), 1577-1581.
15. Collier, J.; Dickinson, D.; McKechnie, S. EMEA and consumer representation. *Lancet.* **1997**, 350 (9084), 1107.
16. Felix, F.S.; Brett, C.M.; Angnes, L. Carbon film resistor electrode for amperometric determination of acetaminophen in pharmaceutical formulations. *J. Pharm. Biomed. Anal.* **2007**, 43 (5), 1622-1627.
17. Ramos, M.L.; Tyson, J.F.; Curran, D.J. Determination of acetaminophen by flow injection with on-line chemical derivatization: Investigations using visible and FTIR spectrophotometry. *Anal. Chim. Acta.* **1998**, 364 (1-3), 107-116.
18. Sun, D.; Zhang, H. Electrochemical determination of acetaminophen using a glassy carbon electrode coated with a single-wall carbon nanotube-dicetyl phosphate film. *Microchim. Acta.* **2007**, 158 (1-2), 131-136.
19. Li, M.; Jing, L. Electrochemical behavior of acetaminophen and its detection on the PANI-MWCNTs composite modified electrode. *Electrochim. Acta.* **2007**, 52 (9), 3250-3257.
20. Felix, F.S.; Angnes, L. Fast and accurate analysis of drugs using amperometry associated with flow injection analysis. *J. Pharm. Sci.* **2010**, 99 (12), 4784-4804.
21. Wang, C.; Li, C.; Wang, F.; et al. Covalent modification of glassy carbon electrode with L-cysteine for the determination of acetaminophen. *Microchim. Acta.* **2006**, 155 (3-4), 365-371.
22. Lin, Y.T.; Yantasee, W.; Ren, Z. Carbon Nanotubes based nanoelectrode arrays. *Electroanalysis.* **2005**, 17 (1), 79-84.
23. Kachosangi, R.T.; Wildgoose, G.G.; Compton, R.G. Sensitive adsorptive stripping voltammetric determination of paracetamol at multiwalled carbon nanotube modified basal plane pyrolytic graphite electrode. *Anal. Chim. Acta.* **2008**, 618 (1), 54-60.
24. Kang, X.; Wang, J.; Wu, H.; et al. A graphene-based electrochemical sensor for sensitive detection of paracetamol. *Talanta.* **2010**, 81 (3), 754-759.

25. Bosch, M.E.; Sánchez, A.R.; Rojas, F.S.; et al. Determination of paracetamol: Historical evolution. *J. Pharm. biomed. Anal.* **2006**, 42 (3), 291-321.
26. Christie, I.; Leeds, S.; Baker, M.; et al. Direct electrochemical determination of paracetamol in plasma. *Anal. Chim. Act.* **1993**, 272 (1), 145-150.
27. Vieira, I.C.; Lupetti, K.O.; Fatibello, O. Determination of paracetamol in pharmaceutical products using a carbon paste biosensor modified with crude extract of zucchini (*Cucurbita pepo*). *Quím. Nova.* **2003**, 26 (1), 39-43.
28. Săndulescu, R.; Mirel, S.; Oprean, R. The development of spectrophotometric and electroanalytical methods for ascorbic acid and acetaminophen and their applications in the analysis of effervescent dosage forms. *J. Pharm. biomed. Anal.* **2000**, 23 (1), 77-87.
29. Gilmartin, M.A.; Hart, J.P. Novel, reagentless, amperometric biosensor for uric acid based on a chemically modified screen-printed carbon electrode coated with cellulose acetate and uricase. *Analyst.* **1994**, 119 (5), 833-840.
30. Lahav, M.; Shipway, A.N.; Willner, I. Au-nanoparticle-bis-bipyridinium cyclophane superstructures: assembly, characterization and sensoric applications. *J. Chem. Soci. Perkin transaction.* **1999**, 2 (9), 1925-1931.
31. El Mhammedi, M.A.; Achak, M.; Bakasse, M. Physico-chemical characterization of electrochemical deposit of $\text{Ca}_{10}(\text{PO}_4)_6(\text{OH})_2$ on copper surfaces. *App. Sur. Sci.* **2007**, 253 (14), 5925-5930.
32. El Qouatli, S.; Najih, R.; Hambate, V. Electrochemical Studies and Square Wave Voltammetry of Paracetamol at Manganese Modified Carbon Paste Electrode. *Pharm. Anal. Acta.* **2013**, 4 (412), 1-5.
33. Rajendra, N.G.; Vinod, K.G.; Munetaka, O.; et al. Differential pulse voltammetric determination of paracetamol at nanogold modified indium tin oxide electrode. *Electrochem. Commun.* **2005**, 7 (8), 803-809.
34. Zidan, M.; Tee, T.W.; Abdullah, A.H.; et al. Electrochemical oxidation of paracetamol mediated by MgB_2 microparticles modified glassy carbon electrode. *J. Chem.* **2011**, 8 (11), 553-560.
35. Fan, Y.; Liu, J.H.; Lu, H.T.; et al. Electrochemical behavior and voltammetric determination of paracetamol on Nafion/ TiO_2 -graphene modified glassy carbon electrode. *Colloids. Surf. B.* **2011**, 85 (2), 289-292.
36. Engin, C.; Yilmaz, S.; Saglikoglu, G.; et al. Electroanalytical investigation of paracetamol on glassy carbon electrode by voltammetry. *Int. J. Electrochem. Sci.* **2015**, 10 (4), 1916-1925.
37. Lourencao, B.C.; Medeiros, R.A.; Rocha-Filho, R.C.; et al. Simultaneous voltammetric determination of paracetamol and caffeine in pharmaceutical formulations using a boron-doped diamond electrode. *Talanta.* **2009**, 78 (3), 748-752.
38. Pournaghi-Azar, M.H.; Saadatirad, A. Simultaneous determination of paracetamol, ascorbic acid and codeine by differential pulse voltammetry on the aluminum electrode modified by thin layer of palladium. *Electroanalysis.* **2010**, 22 (14), 1592-1598.