Waste sponge derived carbon-Co_3O_4 nanoparticle based nanosensor for the sensitive determination of ruxolitinib from its dosage form and biological samples

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In the last decade, the use of carbon materials obtained through green synthesis from agricultural, animal, domestic, and industrial wastes in electrochemical sensing applications has increased dramatically. Carbon materials obtained from wastes have many fascinating properties such as high surface area, good pore size distribution, high electrical conductivity, chemical stability, good mechanical strength, superior electrocatalytic performance, and great active site. Cobalt oxide nanoparticles (Co_3O_4 NPs) are indispensable for electrochemical sensor applications due to their excellent reversible redox ability, superior magnetic properties, relatively high surface area, excellent semiconductivity, high catalytic performance, good chemical stability, and high corrosion resistance.

Compared to other techniques, electroanalytical-based techniques are thoroughly used for the detection of a wide variety of drug compounds due to their economic, limited chemical consumption, good selectivity, excellent sensitivity, and rapid analysis time; furthermore, there is no need for complicated sample preparation procedures. Surface modification strategies are critical in the field of electrochemical applications. Therefore, the main feature of electrodes modified with nanomaterials, which are widely used in electroanalysis, is their ability to reduce overpotential and prevent contamination for many electrochemical processes of analytical importance [1].

Janus kinases (JAKs) are inhibitors of four (JAK1, JAK2, JAK3, and 2 TYK2)cytoplasmic tyrosine kinases that play a critical role in hematopoiesis. Ruxolitinib (RUX) is one of the most selective inhibitors belonging to the JAK1-JAK2 group, which is found in the signaling pathway of various cytokines and growth agents.

The purpose of this study is to investigate and discuss the detailed voltammetric behavior and sensitive analysis of RUX by means of waste sponge-cobalt oxide nanoparticles modified GCE (WS-Co_3O_4-GCE) using cyclic voltammetry (CV) and adsorptive stripping differential pulse voltammetry (AdSDPV). The developed nanosensor exhibits high sensitivity, fast response and good reproducibility. This nanosensor can be used for sensitive and selective analysis of RUX in pharmaceutical dosage forms. The originality of this study is that for the first time, functional carbon materials obtained from waste sponges are used together with Co_3O_4 nanoparticles as electrode modification and the modification properties of each material are elucidated through various characterization techniques. This study will provide a more environmentally friendly and green perspective to the studies in the field of electrode modification.

Under optimum experimental conditions, calibration curves for RUX were obtained as 20uM – 80 nM with a limit of detection (LOD) of 6.7 nM by the WS-Co_3O_4-GCE using AdSDPV. The proposed method is validated and successfully performed to analyze the RUX in tablet dosage forms and human serum samples with great accuracy, recovery, and precision. There are no interferences from the excipients and endogenous substances obtained in the tablet dosage forms and human serum samples.

References

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