RESCON 2025 PS 15

CONTROLLED RELEASE OF METFORMIN USING MIL-101(Fe): A PROMISING METAL ORGANIC FRAMEWORK FOR DRUG DELIVERY APPLICATIONS

J.P.I.U. Rathnayake[1] and C.V. Hettiarachchi[2]*

[1]*Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka.*
[2]*Department of Chemistry, University of Peradeniya, Peradeniya, Sri Lanka.*
*champikav@sci.pdn.ac.lk

Metal organic frameworks (MOFs) are emerging porous materials with great potential as drug delivery vehicles due to their tuneable porosity, high surface area, and large pore volume. Among them, the iron-terephthalate MOF, MIL-101(Fe) has great potential due to its large pore volume and wide pore windows. Despite its favourable characteristics, the application of MIL-101(Fe) in drug delivery remains relatively underutilised. This study investigated the use of MIL-101(Fe) for the controlled release of the antihyperglycemic drug metformin, which typically suffers from low bioavailability and potential side effects when administered directly. MIL-101(Fe) was synthesised via a modified solvothermal method to obtain a high-purity product. Metformin loading was performed in duplicate in ethanolic medium using 25 mg of the MOF in 50 mL of 500 mg L^{-1} metformin solution, and it was quantified at 231 nm with UV-visible spectrophotometry. Drug release was studied in duplicate in phosphate-buffered saline (PBS) at pH 7.4 and HCl at pH 4.0 at 37 °C over 48 h, mimicking intestinal and postprandial stomach environments, respectively. PXRD confirmed the expected MOF structure. UV-visible spectroscopy revealed a metformin loading capacity of 0.19 mg mg^{-1} of MOF and a loading efficiency of 19%. The release profiles demonstrated a gradual and sustained release, with no initial burst effect. After 48 h, release efficiencies were 72% in HCl and 61% in PBS, calculated using the UV-visible data. These findings not only highlight the potential of MIL-101(Fe) as a carrier for metformin but also emphasise the need for post-synthetic modifications to minimise the drug release under stomach conditions. Future work would focus on functionalising the MOF with negatively charged groups to enhance drug loading and broaden its applicability to other pharmaceutical agents.

Keywords: Controlled release, Drug delivery, Metal organic frameworks, Metformin, MIL-101(Fe)