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EFFECT OF GREEN POLYMERISATION VIA MICROWAVE-ASSISTED SYNTHESIS ON MORPHOLOGY, SIZE, AND REBINDING PROPERTIES OF ASPIRINATE MOLECULARLY IMPRINTED POLYMER

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Abstract: Molecularly imprinted polymer (MIP) has been vastly investigated for various applications including drug delivery systems. Precipitation polymerisation has been widely used in the preparation of MIP to obtain small-size polymer beads that are vital in drug delivery applications. However, the process requires a longer time and produces larger polymer particles which often appears as a constraint for large-scale production and drug delivery applications. In this study, a series of MIPs were synthesised via microwave (MW) irradiation employing aspirin as template in the present of methacrylic acid (MAA) as functional monomer and divinylbenzene as crosslinker in acetonitrile at 80°C (MW80 in 60 minutes), 100°C (MW100 in 15 minutes), 110°C (MW110 in 8 minutes) and 120°C (MW120 in 4 minutes). MW110 produced homogeneous spherical particles (1.24 µm ± 0.17 µm), higher yield (0.62 g) and excellent rebinding capacity (7.27 mg/g) compared with other MIPs. Green synthesis of MIP via MW emerged as a powerful tool for well-controlled, rapid reactions and is significantly useful for drug delivery applications.

Keywords: drug delivery, Molecularly imprinted polymer, microwave irradiation optimisation, microsphere, green synthesis.

Introduction

Molecularly imprinted polymers (MIPs) have garnered significant attention due to their exceptional selectivity and unique properties (Díaz-Álvarez *et al*., 2023) for a variety of fields, such as environmental monitoring (Quinto *et al*., 2019; Li *et al*., 2020), food analysis (He *et al*., 2019; Aghoutane *et al*., 2020), biomedical diagnostics (Ayankojo *et al*., 2020) and drug delivery (Sajini *et al*., 2019; Jantarat *et al*., 2020). The MIPs are easily prepared *via* pre-polymerisation of the template and functional monomers complex, followed by co-polymerisation with crosslinker and the removal of the template a cavity (Samarth *et al*., 2015; Xiao *et al*., 2020).

Typically, bulk polymerisation, precipitation polymerisation, pickering emulsion polymerisation, multi-step swelling polymerisation, and surface imprinting processes are used in the conventional heating process of synthesising MIP (Ertürk & Mattiasson, 2017; Fresco-Cala *et al*., 2020). Nevertheless, the conventional method offers a longer reaction time (six to 24 hours) and uneven heat distribution prompts the exploration of alternative approaches (Kueseng *et al*., 2018). In recent years, MW-assisted synthesis has emerged as an alternative and efficient technique for polymerisation (Lamaoui *et al*., 2021). MW-assisted synthesis is a fast and well-controlled reaction used extensively in organic synthesis and recently explored in polymerisation reactions (Brahmbhatt *et al*., 2020). The polymerisation of MIPs *via* MW has been reported as a rapid synthesis with lower energy consumption compared with conventional heating (Chen *et al*., 2015; Liang *et al*., 2018; Lamaoui *et al*., 2021; Zhang *et al*., 2021). The green synthesis of MIPs *via* MW irradiation has significantly influenced the overall performance, structural characteristics,