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*Research Article*

# Porous Cellulose Beads Fabricated from Regenerated Cellulose as Potential Drug Delivery Carriers

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Highly porous cellulose beads (CBs) of various mean sizes were successfully prepared from regenerated cellulose of paper wastes. The drug delivery characteristics of CBs with different mean sizes were investigated using curcumin as the model drug under controlled conditions. The loading capacity and efficiency of curcumin onto CBs were substantially influenced by factors such as their morphological characteristics, curcumin concentration, and duration of loading. The release kinetic profiles of curcumin from CBs of different mean sizes were investigated in media of pH values resembling digestive juices and intestinal fluids. Release kinetic models were used to simulate and elucidate release kinetics and mechanisms of curcumin from CBs under specific conditions. The loading capacity and efficiency of curcumin onto CBs could be enhanced via the optimization of curcumin solution concentration and the morphological characteristics of CBs, whereas the release kinetic profiles of curcumin from CBs could be modulated by varying the mean diameter of CBs. Optimized CBs derived from regenerated cellulose of paper wastes are potentially useful as cost-effective drug delivery carriers.

## 1. Introduction

In recent years, porous cellulose beads (CBs) derived from regenerated cellulose are receiving intense research interest for their potential biomedical and biotechnological applications such as chromatography system [1], immobilization of enzymes [2], and drug delivery system [3]. CBs are potentially cost-effective drug delivery carriers due to their high porosity and high specific surface area, favourable drug loadings, and release profiles under specific conditions [4]. Importantly, CBs are nontoxic, biocompatible, cheap, and possess excellent thermal and mechanical properties [5, 6].

In the pharmaceutical field, CBs constitute the main component in the formulation of drug pellets using the extrusion-spheronization method [7]. CBs are prepared by mechanically shaping the wet hydrolyzed cellulose fibre fragments into spherical particles through spheronization and then loaded with model drugs such as isosorbide dinitrate, terodiline, and N-actyl-L-cysteine for subsequent drug release studies [8, 9]. However, the main disadvantages of the extrusion-spheronization method were difficulties in controlling the size and porous structure of CBs formed which could lead to burst release instead of sustained release of drug components from the delivery system. The drug release time could be increased by loading CBs with paracetamol containing lipophilic release modifiers using the absorption method [10]. Different hydrophilic and hydrophobic model drugs such as anhydrous theophylline, riboflavin 5′-phosphate sodium, and lidocaine hydrochloride monohydrate had been incorporated into spherical CBs by the immersion method for studying their drug release profiles [3]. In addition, the effects of functionalized cellulose matrix and types of drugs on their release profiles from CBs were investigated [11, 12]. The preparation of CBs with spherical shape and mean diameter within the range of micrometer to millimeter were reported by several researchers via three main steps: dissolution of cellulose, shaping of the cellulose solution, and solidifying or precipitate the solution in a coagulation bath to form beads [13, 14]. However, due to insolubility of cellulose fibres in water and most organic solvents, all these CBs preparation approaches required the use of derivatizing solvents and