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SYNTHESIS AND CHARACTERIZATION OF β-CYLODEXTRIN/ALGINATE AEROGEL DRIED BY AMBIENT DRYING

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ABSTRACT

Aerogel is an attractive candidate for the drug delivery system in order to increase dissolved compounds solubility because of its excellent features with large surface area and high pore volume. These properties can only be obtained when the materials are dried by supercritical CO_2 ($SCCO_2$) to remove liquids present in solid pores. However, this method is so power-intensive and dangerous that it is difficult to practice and sell. Therefore it is very important to synthesize aerogels at a reasonable cost using an ambient pressure drying technique. Even though aerogels have a comparatively elevated compression strength, the structural power of aerogels is not great, because it is very brittle owing to its very small tensile strength and because of the quantity of water in its framework of 99%, they break readily when the stress and heavy load pressure applied to it. The aim of this work were to determine the suitable ratio for the formation of aerogel and to study the morphology and properties of β-cyclodextrin (β-CD)/alginate aerogel. Percentage of shrinkage level for aerogel decrease as the amount of B-cyclodextrin increase. β-CD mixed with alginate to form aerogels enhanced the thermal stability and the rate of decomposition. The application of β-cyclodextrin results in more stable aerogel decomposition about 270 to 290^{o}C for each sample except B1 and B2. The surface area of aerogel increase when β-CD introduced to sodium alginate at first but the surface area suddenly decrease when the amount of β-CD increase which also give a results to low porous structure of aerogel. Lastly, the pore volume of each sample increase as the amount of β-CD increase.

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CHAPTER ONE
INTRODUCTION

1.1 Research background

Throughout recent years, biomaterials have been commonly used for continuous delivery systems to enhance drug safety, effectiveness and consumer enforcement. The efficacy of the drug molecules can be significantly increased by controlling their release and distribution within the body. According to (Gidwani and Vyas 2015) water solubility and dissolution rate are two critical factors that affect the medication process formulation and development and limit their therapeutic applications.

Among biomaterials, aerogels have gained a lot of attention in the field of pharmaceuticals. Due to its low density, high specific surface area, high porosity and other outstanding characteristics, aerogel has a broad variety of applications in catalysts, adsorbents, thermal or noise insulation material, drug carriers and other materials (Barrios, Fox et al. 2019). Aerogel has attracted more and more attention as a drug carrier. However, the two most important factors for drug carriers in the pharmaceutical industry are biocompatibility and biodegradability (Mehling, Smirnova et al. 2009).

In the past research in 1995, drug delivery system was prepared with hydrophilic and hydrophobic silica aerogels. The appropriate aerogels were balanced by drug solution adsorption, then filtered and dried as drug carrier to make loaded aerogels. Although silica aerogels have high particular surfaces and excellent biocompatibility, they are small in pharmaceutical applications due to bad biodegradability. To fix these issues, aerogels based on polysaccharides were first suggested for drug carriers in 1995 (Yun, Luo et al. 2014). Due to its low toxicity, reproduction and good biological performance, aerogel polysaccharides, such as sodium alginate (Veronovski, Knez et al. 2013) and chitosan (Assaad, Wang et al. 2011) are used as a drug carrier.

An alginate is described as a natural polysaccharide biopolymer extracted from brown algae. It includes α-L-guluronic acid and β-D-mannuronic acid (M) residues that are linearly linked to 1,4-glycosidic connection (Paques, van der Linden et al. 2014). It is used as a gelling agent, a stabilizer for colloids and a suspender. In various fields such as biomedical, pharmaceutical, absorption due to biodegradable, biocompatible, non-toxic, low cost and stable, natural biopolymer has been widely used. Alginate aerogel characterized by the combination of unique aerogel characteristics and particularly high surface polysaccharides, open porosity, good compatibility and biodegradable