Guar gum Microspheres as Prospective Carrier for Biotechnological Drugs

Shitika Sharma, Medha Rana, Sangeeta Thakur and Kalpana Chauhan*
School of Chemistry, Shoolini University, Solan, India - 173229.
*email: kalpana13chauhan@gmail.com

Abstract

Guar gum has received consideration in the field of colon targeted delivery of protein/biotechnological drug due to its retard gelling property and susceptibility to degradation in the colonic environment. Biobased hydrogels being biocompatible material have been recognized to function as drug protectors, especially for peptides and proteins from in vivo environment. Grafting with active functionality further potentiate the properties of polysaccharide for the intended application. Hence, in the present study crosslinked microspheres of functionalized guar gum were prepared by emulsion method using N,N-MBAm as a crosslinker. The synthesized particulate guar gum was characterized by different physical methods i.e., FTIR and SEM. BSA, as the biotechnological model drug was taken as a model for the better understanding of these drugs in physiological conditions, when that is encapsulated within the particulate functionalized polysaccharide.

1. Introduction

The oral delivery of peptides and proteins to the gastrointestinal (GI) tract is one of the most challenging issues in relation to protein inactivation and poor epithelial permeability of the hydrophilic drugs[1]. The nano/micro structure based hydrogels have been reported to be efficient encapsulater for much diverse class of the drugs[2]. Biobased hydrogels being biocompatible material have been recognized to function as drug protectors, especially for peptides and proteins from *in vivo* environment in particulate shape[3]. The incorporation of the ionogenic or polyelectrolyte groups (-$CONH_2$, -COOH and -SO_3H) in natural polymers further increases their biocompatible nature[4]. BSA, a serum albumin protein is used as a model for biotechnological drugs because of its stability and of its low cost. So, the present study is focused on the synthesis of efficient guar gum based hydrogels/microspheres as a proficient carrier for biotechnological drugs.

2. Experimental:

2.1. Materials and method

The chemicals used for the study were of analytical grades and used as received. The hydrolyzed guar gum (GG_H) was grafted with MAc in the molar ratio of 1:1 at 65°C. Crosslinked microspheres of GG_H-*g*-poly(MAc) with GA were prepared by the w/o emulsion crosslinking method. The product formed was collected by decantation of oil and after that by centrifugation and filtration. The microspheres were washed with isopropyl alcohol and then vacuum dried.

2.2. Characterization of product

FTIR spectra were recorded using KBr pallets on Perkin Elmer and SEMs of the polymer were recorded on Joel JSM 6100.

2.3. Swelling study of microspheres

In order to study the physiological responsiveness of synthesized product the swelling study was done at different physiological simulated medium (pH 2.2 and 6.8) at 37°C by gravimetric method.

2.4. Drug loading by microspheres

Loading of BSA on the synthesized hydrogels i.e., GG_H-*g*-poly(MAc) and GG_H-*cl*-poly(MAc) was carried out for 2h at a constant temperature of 37°C. The concentration of drug in the rejected solution was determined by using a UV spectrophotometer (UV mini 1240 spectrophotometer). The drug content of the loaded polymers was calculated by the following equation.

$$\text{Drug content} = \frac{\text{Amount of drug in polymer}}{\text{Amount of polymer recovered}}$$

3. Results and Discussion

Grafting of MAc on to GG_H was carried out by chemical method using APS as initiator system. The percent efficiency for the network formation was 83.00%, which shows the efficiency of the applied protocol.

3.1. FTIR spectroscopy

The spectrum of GG_H shows characteristic peaks in the range of 3200-3500 cm^{-1} (for O-H stretching, due to the polymeric association) and

800-1200 cm^{-1} (C-O and C-C stretching vibrations of the hexopyranosyl moiety)[4]. GG_H-*g*-poly(MAc) shows characteristic peaks at 1717.6 cm^{-1} and 1653.1 cm^{-1} due to the C=O of carboxylate ion (Fig. 1). The modification and the efficiency of the protocol can also be supported in terms of intensity of the characteristic peaks of the particular functionality.

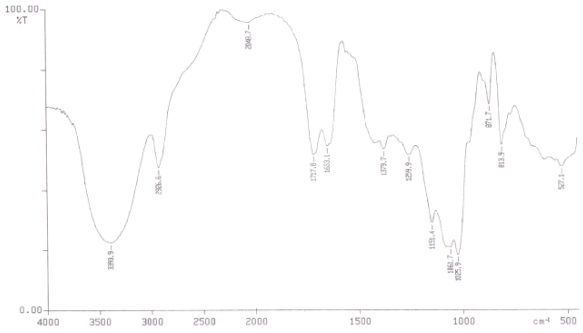

Figure 1. FTIR spectrum of GG_H-*g*-poly(MAc).

3.2. SEM Characterization

SEM confirms the particulate structure for the synthesized GG_H-*cl*-poly(MAc) (Figure 2). Furthermore, results also show the uniform porosity of the matrix and also the individual involvement of the particle in network formation.

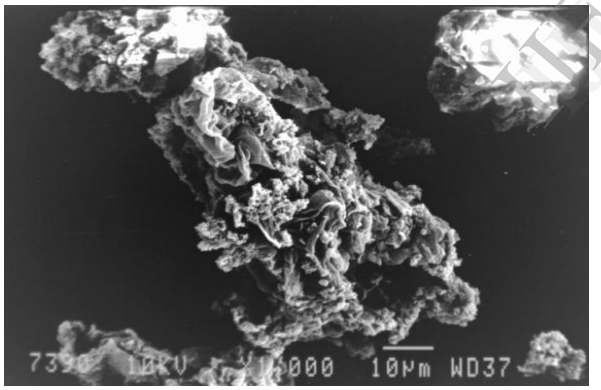

Figure 2. SEM image for GG_H-*cl*-poly(MAc).

3.3. Drug loading efficiency

The maximum drug loading or encapsulation efficiency was 32.91 % and 53.54 % for GG_H-*g*-poly(MAc) and GG_H-*cl*-poly(MAc), respectively (Figure 3). The loading result is better for GG_H-*cl*-poly(MAc) because of the maximum water uptake property of the hydrogel (Figure 3).

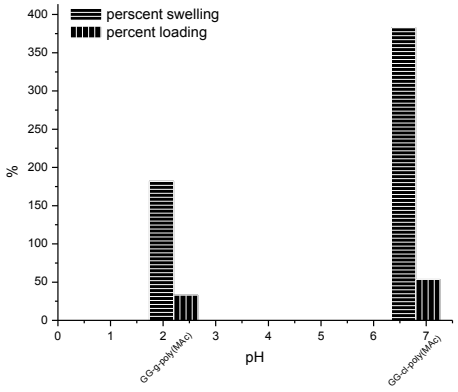

Figure 3: Loading Efficiency for hydrogels.

4. Conclusions

The synthesis of particulate structures of biopolymer follows green protocol with respect to zero waste generation and ambient condition of synthesis. The encapsulation results show the proficiency of networks (53.54 %) in contrast to graft copolymer (32.91 %) for BSA. In conclusion, better results for loading can be obtained by modifying the applied protocol.

5. References

1. L. Xing, C. Daweia, X. Liping and Z. Rongqing, *Journal of Controlled Release*, **93,** 293–300 (2003).
2. V.J. Mohanraj and Y. Chen, *Tropical Journal of Pharmaceutical Research*, **5 (1),** 561-573 (2006).
3. K.M. Manjanna, T.M.P. Kumar and B.S. Kumar, *Int. J. Chem. Tech. Res.*, **2(1)**, 509-525 (2010).
4. N.V. Gupta and H.G.S. Kumar, *Tropical Journal of Pharmaceutical Research*, ***9(3)***, 257-264 (2010).
5. K. Chauhan, G. Chauhan and J.-H.Ahn, *Bioresource Technology*, **100,** 3599-3603 (2009)