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Ethyl cellulose-chitosan microspheres of sumatriptan succinate for nasal drug delivery

Salah Alghareeb, Adeola O. Adebisi*

Department of Pharmacy, School of Applied Sciences, University of Huddersfield, Queensgate, Huddersfield HD1 3DH, UK

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*Corresponding author.
Tel.: +44 01484 256949
E-mail: A.Adebisi@hud.ac.uk

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SUMMARY

The research investigated the preparation of mucoadhesive microspheres using ethyl cellulose and chitosan as polymers. Two methods were employed, with the first method utilizing an emulsion solvent evaporation technique and the second method incorporating additional homogenization and sonication steps. The results showed that the first method yielded nearly perfect spherical microspheres with a particle size range of 50 µm, while the second method produced irregularly shaped microspheres with larger particle sizes within the range of 200 µm. The drug entrapment efficiency was significantly higher in the first method compared to the second method, and within the first method, drug entrapment efficiency decreased with increasing chitosan concentration. These findings underscore the importance of method selection and chitosan concentration in microsphere synthesis, providing insights for optimizing drug delivery systems for targeted applications.

INTRODUCTION

Migraine presents as a severe neurological disorder distinguished by nausea, vomiting and unilateral throbbing headache, impacts roughly 15% of women and around 6% of men (Masjedi et al., 2021). In 1991, the US Food and Drug Administration (FDA) granted approval for Sumatriptan succinate (SMT), a 5-hydroxytryptamine agonist, as the inaugural medication from the triptan class to manage acute migraine attacks (Patel et al., 2012). For this current investigation, ethyl cellulose (EC) and chitosan (CH) were utilized as polymers to create sumatriptan loaded mucoadhesive microspheres for nasal drug delivery. This research aims to examine the impact of homogenization and sonication techniques on the drug entrapment efficiency, the shape and size of the resulting microspheres.

MATERIALS AND METHODS

Two methods were employed to prepare the microspheres. In the first method is the emulsion solvent evaporation technique, drug, EC, and varying concentrations of CH were dissolved in dichloromethane (DCM). Additionally, 1% aqueous solution of PVA surfactant was prepared. The polymer-drug solution was injected into the aqueous surfactant solution using a syringe pump under mechanical stirring at 2000 rpm. This process was carried out following the methodology outlined by Adebisi and Conway (Adebisi & Conway, 2014). The second method followed a similar procedure as the first method, with the additional step of homogenization at 12,000 rpm, followed by probe sonication at 50% amplitude.

RESULTS AND DISCUSSION

The results of the first method demonstrated the successful formation of nearly perfect spherical-

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shaped microspheres, exhibiting a particle size distribution within the range of 50 µm (figure 1). In contrast, the second method yielded microspheres with irregular shapes and larger particle sizes, falling within the range of 200 µm as shown in figure 2. These observations highlight the critical influence of the chosen method on the morphology and particle size characteristics of the microspheres. The precise and uniform morphology observed in the first method may indicate better control over the synthesis process, potentially offering advantages for specific applications such as targeted drug delivery.

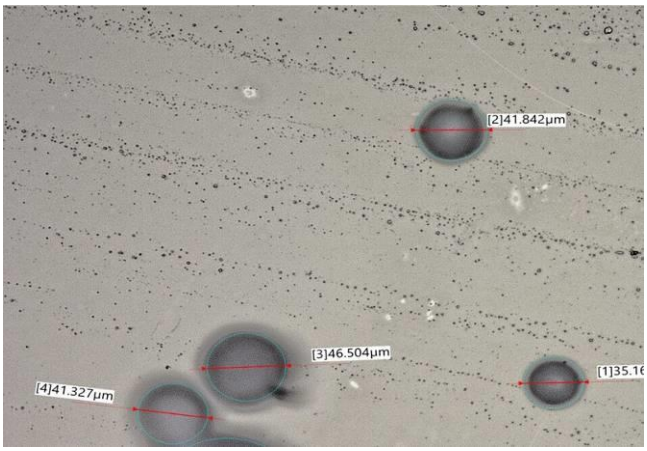

Fig. 1. *Showed S3-1 microspheres prepared by the emulsion solvent evaporation technique.*

The results of the drug entrapment investigation revealed that the first method exhibited a notably higher drug entrapment efficiency in comparison to the second method.

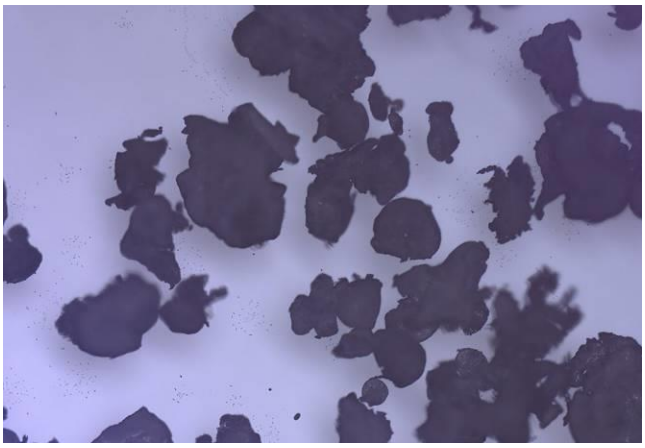

Fig. 2. *Showed S3-1 micro-particles prepared by second method.*

Furthermore, within the first method, it was observed that as the concentration of chitosan increased, the drug entrapment efficiency decreased. The corresponding entrapment efficiencies were determined to be 19.42%, 17.22%, and 13.73%, respectively. Conversely, for the second method, the entrapment efficiency remained relatively consistent across the different chitosan concentrations, with values of 5.65%, 5.65%, and 5.05% respectively.

Table 1. *formulation variables for both methods used in this study.*

Code	EC (%w/w)	SMT (%w/w)	CH (%w/w)
S1-0.3	4	1	0.3
S2-0.6	4	1	0.6
S3-1	4	1	1

CONCLUSIONS

In conclusion, the emulsion solvent evaporation method produced uniform spherical microspheres with higher drug entrapment compared to the irregularly shaped particles obtained through the second method with homogenisation and sonication techniques. Chitosan concentration influenced drug entrapment in the emulsion solvent evaporation method. These findings highlight the significance of selecting appropriate methods and chitosan concentrations for microsphere synthesis and drug delivery applications. Further optimization is crucial to maximize the performance of microspheres for targeted drug delivery purposes.

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