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DEVELOPMENT AND CHARACTERIZATION OF METOCLOPRAMIDE HOLLOW MICROSPHERES

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ABSTRACT

This study aims to develop and characterize hollow microspheres of metoclopramide designed for enhanced absorption in gastric pH conditions. The microspheres were prepared using an emulsion solvent diffusion method with polymers such as sodium alginate, ethyl cellulose, and carbopol 934. Key parameters like buoyancy, yield percentage, drug entrapment efficiency, and in vitro drug release were evaluated. Characterization through FT-IR confirmed no significant drug-polymer interactions, and SEM analysis revealed a smooth, dense external surface with a porous interior, prolonging the microspheres' floating capacity. In vitro release studies demonstrated controlled drug release over an 8-hour period, indicating that the hollow microspheres are suitable for gastroretentive drug delivery of metoclopramide, potentially enhancing patient compliance and therapeutic efficacy.

KEYWORD: Metoclopramide, Hollow microspheres, Controlled release, Gastroretentive, Emulsion solvent diffusion, Drug delivery.

1. INTRODUCTION

Oral drug delivery remains the most common route of administration due to its convenience and ease of use. However, conventional oral dosage forms often lead to fluctuating drug levels in the bloodstream, which necessitates multiple doses throughout the day. Recent advances in novel drug delivery systems (NDDS) have aimed to address these limitations by providing sustained or controlled release of the drug across the gastrointestinal (GI) tract.

For drugs like metoclopramide, which are primarily absorbed in the stomach and upper intestines, gastroretentive drug delivery systems (GRDDS) are ideal. These systems prolong the drug's residence time in the stomach, enabling enhanced absorption and bioavailability. In this study, hollow microspheres of metoclopramide were formulated using various polymers to achieve sustained drug release, thereby improving therapeutic outcomes.

2. MATERIALS AND METHODS

2.1 Materials

Metoclopramide was procured from AR Chemicals, and polymers such as sodium alginate, ethyl cellulose, and carbopol 934 were utilized. All other reagents and solvents, including dichloromethane and water, were of analytical grade.

2.2 Preparation of microspheres

The hollow microspheres were prepared using the emulsion solvent diffusion technique. Different drug-to-polymer ratios were tested to optimize the formulation. Briefly, metoclopramide was dissolved in water, and the polymer was dissolved in dichloromethane. The drug-polymer mixture was then emulsified using a magnetic stirrer, followed by solvent evaporation to form microspheres. The resulting microspheres were collected, washed, and dried.

2.3 Evaluation of microspheres

2.3.1 Particle size analysis

The particle size of the microspheres was determined using a set of sieves, with sizes ranging from 14 to 30 mesh. The average particle size for all formulations was calculated, and the results indicated a size range between 799 and 841 µm.

2.3.2 Buoyancy and Floating properties

The buoyancy of the microspheres was evaluated by placing them in simulated gastric fluid (pH 1.2) and monitoring the floating time. It was observed that larger particle sizes corresponded to longer floating durations.

2.3.3 Drug entrapment efficiency

The efficiency of drug entrapment was calculated by comparing the theoretical and actual drug content in the

microspheres. The drug entrapment efficiency ranged from 75.20% to 89.68%, with higher polymer concentrations resulting in increased drug entrapment.

2.3.4 In vitro drug release

In vitro drug release studies were conducted using a dissolution apparatus in phosphate buffer (pH 1.2). The cumulative drug release was measured over 8 hours, demonstrating sustained release for the optimized formulation.

3. RESULTS AND DISCUSSION

3.1 FT-IR and SEM Characterization

FT-IR analysis confirmed that no significant chemical interaction occurred between metoclopramide and the polymers used. The microspheres retained the characteristic peaks of metoclopramide, indicating stability during the formulation process. Scanning electron microscopy (SEM) revealed a smooth, dense outer surface with a porous internal structure, which contributed to prolonged floating behavior in gastric fluids.

3.2 Drug Release and Buoyancy

The in vitro release profile showed that the metoclopramide-loaded microspheres provided a sustained release over an 8-hour period. Formulation F2, with an optimal balance between buoyancy and drug release, exhibited the best performance, with 95.56% drug release after 8 hours. The buoyancy results confirmed that the microspheres could float for extended periods, making them ideal for gastroretentive drug delivery.

3.3 Comparison with existing literature

Compared to conventional immediate-release dosage forms, the hollow microspheres developed in this study provided controlled drug release and prolonged gastric retention. These properties align with the requirements for effective gastroretentive delivery systems, as described in previous studies on similar formulations.

4. CONCLUSION

The study successfully formulated and evaluated hollow microspheres of metoclopramide using the emulsion solvent diffusion technique. The prepared microspheres demonstrated desirable characteristics, including sustained drug release, high drug entrapment efficiency, and extended buoyancy. These microspheres have the potential to improve the bioavailability and therapeutic efficacy of metoclopramide, making them suitable for use in gastroretentive drug delivery systems.

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