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Research Article

DETERMINATION OF SUITABLE METHOD OF PREPARATION OF MICROCAPSULES FOR BOTH WATER SOLUBLE AND INSOLUBLE DRUG

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ABSTRACT

In recent years, wide varieties of newer oral drug delivery systems are designed and evaluated in order to overcome the limitations of conventional therapy. Different studies have shown the feasibility of alginate-based microcapsules in the modern approach of drug delivery with safe, effective and well-controlled drug release profile. The aim of the present study was to develop and identify the suitable method for the preparation of microcapsules for both water soluble and water insoluble drug viz. Amoxicillin and Diclofenac sodium respectively, using a natural polymer sodium alginate. Microcapsules beads were prepared by three different techniques: Drug in calcium chloride solution, drug in sodium alginate solution and 3. via soaking technique of drug solution by unmediated microcapsules. It was observed that formulation prepared by soaking unmediated microcapsules in drug solution has the highest percentage yield compared to other techniques (64.11% for amoxicillin and 48.55% for Diclofenac Sodium). Also, higher drug content was found for those microcapsules thus suggesting the highest entrapment efficiency of 56.40 % for Amoxicillin and 68.95% for Diclofenac Sodium respectively. *In-vitro* dissolution study of prepared microcapsules by different techniques suggested comparatively similar dissolution profile. The study concludes that the microcapsules prepared by soaking of unmediated microcapsules in drug solution resulted in maximum percentage yield along with high drug entrapment efficiency and controlled drug release profile for both drugs. The study is feasible in higher scale and demands a pilot study.

Keywords- Microcapsule, alginate, Amoxicillin, Diclofenac Sodium.

INTRODUCTION

In recent years, wide varieties of newer oral drug delivery systems are designed and evaluated in order to overcome the limitations of conventional therapy. An increasing prevalence of various chronic disease has demanded the development of an ideal drug dosage form with extended therapeutic benefit[1-2]. This can be possible either by the development of drug with long half-life or development of dosage form capable of releasing drug gradually[3]. Tremendous research works are continuously being carried to design safe and effective drug delivery with well-controlled drug release profile. Microcapsules being one of the approaches are small solid free-flowing particulate carriers containing dispersed drug particles that allow multiple drug release profiles reducing the amount and frequency of dosing without major side effects[4]. Along with increasing the release properties of the drug compound, microcapsules at present also tend to increase stability, mask the undesirable taste and reduce as a whole cost of production[5]. The aim of the present study was to develop and identify the suitable method for the preparation of microcapsules for both water soluble and water insoluble drug viz. Amoxicillin and Diclofenac respectively using a natural polymer sodium alginate.

MATERIAL AND METHODS

Materials: Amoxicillin and Diclofenac sodium drugs were provided as a gift sample from Aurobindo Pharma Pvt. Ltd, Mumbai, India as a gift sample. Sodium alginate and Calcium chloride were procured from Thermo Fisher Scientific India Pvt. Ltd. Distilled water was used.

Methods: In the current study, microcapsules were prepared using water-soluble amoxicillin and water-insoluble Diclofenac sodium as a model drug. Initially, 50ml of 15% calcium chloride solution and 100 ml of 7% sodium alginate was prepared using distilled water. Amoxicillin was dissolved in about 20ml of distilled water and acetone was used to dissolve Diclofenac sodium to prepare drug solution. Then, three different techniques, A, B, and C were used for drug loading. First technique (A) involved the drug solution introduction to calcium chloride solution, second technique (B) involved well mixing of drug solution with alginate solution using a magnetic stirrer and third technique (C) involved preparation of unmediated microcapsules being soaked in drug solution for 24 hours. The composition of each batch prepared is described in Table I. For the preparation of microcapsules, alginate solution was maintained at about 45-50°C with constant stirring. This solution was added to calcium chloride solution maintained in ice bath dropwise using a syringe to get the microcapsules of the desired size. Microcapsules thus prepared were filtered out and air dried for 48 hours. UV analysis using UV spectrophotometer (Agilent Technologies, USA) was carried out to estimate the drug content by calibration curve method and thus the entrapment efficiency was calculated. Microcapsules prepared by each technique were weighed and dissolution study was carried out using phosphate buffer of pH 6.8 as dissolution medium in USP dissolution apparatus I (Electrolab India Pvt. Ltd, India) maintained at 37±0.5°C sink condition of 900ml volume.

Table I: Formulation of microcapsules

Preparation Technique	*Batch number*	*Drug (250mg)*	*Alginate in 100ml solution*	*Calcium chloride in 50ml solution*
Drug in Calcium chloride solution	A1	Amoxicillin	7 gm.	7.5 gm.
	A2	Diclofenac	7 gm.	7.5 gm.
Drug in sodium alginate solution	B1	Amoxicillin	7 gm.	7.5 gm.
	B2	Diclofenac	7 gm.	7.5 gm.
Soaking of drug solution by unmediated microcapsules	C1	Amoxicillin	7 gm.	7.5 gm.
	C2	Diclofenac	7 gm.	7.5 gm.

Table 2: Characterization of microcapsules

Batch number	*Percentage yield (%)*	*Drug content (mg)*	*Drug entrapment efficiency (%)*	*In vitro dissolution study (% Drug release)*
A1	64.11	84.47	33.78	86.13
B1	57.69	120.12	48.05	92.2
C1	59.06	141.02	56.40	90.34
A2	48.55	112.31	44.92	81.13
B2	39.11	148.60	59.44	79.20
C2	45.67	172.39	68.95	83.35

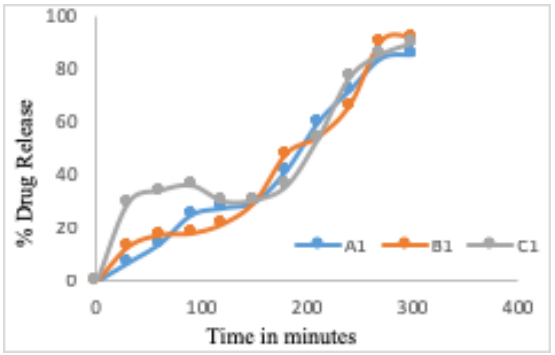

Figure I: In-vitro dissolution profile of Amoxicillin microcapsules prepared by different techniques (A, B and C)

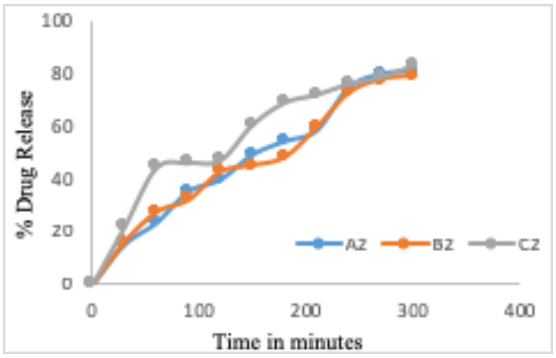

Figure 2: In-vitro dissolution profile of Diclofenac Sodium microcapsules prepared by different techniques (A, B and C)

RESULT AND DISCUSSION

Different studies have shown the feasibility of alginate-based microcapsules in the modern approach of drug delivery. Numbers of microcapsule formulation produced using various polymers (alginate, agar, chitin, gum etc.) are being developed and analyzed in the pharmaceutical field via different method of preparation. Here, the microcapsules prepared via different techniques were characterized for the percentage yield, entrapment efficiency, and drug release profile as shown in Table II. It has been observed that microcapsules prepared by the third technique that is soaking unmediated microcapsules in drug solution have the highest percentage yield 64.11% for water-soluble drug amoxicillin and 48.55% for water-insoluble drug, Diclofenac Sodium. Also, the maximum amount of drug content calculated by calibration curve method suggested the highest entrapment efficiency 56.40 % and 68.95% for Amoxicillin and Diclofenac respectively, also prepared by the third techniques. *In-vitro* dissolution study carried for 5 hours suggested comparatively similar drug profile with the highest drug release by second technique (B) drug in alginate solution for Amoxicillin which is followed by C1 microcapsules by a minimal margin. For Diclofenac, *in-vitro* dissolution study revealed the greater drug release percentage for those microcapsules prepared by soaking unmediated microcapsules in drug solution as shown in figure 1 and 2.

CONCLUSION

The study concludes that the microcapsules prepared by soaking of normally prepared microcapsules in drug solution resulted in maximum percentage yield along with greater drug entrapment efficiency and high drug release profile for both water soluble and water insoluble drugs. The study is feasible in higher scale and demands a pilot study.

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