ORIGINAL ARTICLE

ScienZTech

INTERNATIONAL JOURNAL OF PHARMACEUTICAL RESEARCH AND LIFE SCIENCES

Published by ScienzTech Publication Journal Home Page: www.scienztech.org/ijprls

Novel drug delivery system of Lycopene: Preparation and *in-vitro* investigation

Jeslin D*, Panneerselvam P, Vijayamma G, Suryasree Y, Siddeswari T, Nithyakalyani K

Department of Pharmaceutics, Faculty of Pharmacy, Sree Balaji Medical College Hospital Campus, Bharath Institute of Higher Education and Research, Chromepet, Chennai-600044, Tamilnadu, India

Article History:

Received on: 10 Dec 2020
Revised on: 30 Dec 2020
Accepted on: 12 Jan 2021

Keywords:

NDDS, microspheres, lycopene, physicochemical properties Introduction

ABSTRACT

Compared to pharmaceutical drugs, herbal medications have known to be more affordable and better for the treatment of many diseases but are less effective and not targeted. Therefore, the use of innovative drug delivery devices to distribute herbal drugs is very helpful in enhancing their release, potency and operation. Lycopene was introduced into the muco-adhesive microspheres. Using sodium alginate, carbopol 934, and sodium CMCC, mucoadhesive microspheres were prepared (carboxy methyl cellulose). The prepared microspheres had been evaluated for its physical and physicochemical parameters, invitro release. The prepared microspheres showed consistent physicochemical parameters, release sustained to 8hrs. Herbal drugs can preferably be delivered using novel drug delivery systems after proper chemical and biological standardization.

*Corresponding Author

Name: Jeslin D
Phone: 9488366374
Email: jeslin.123@gmail.com

eISSN: 2321-4589

DOI: https://doi.org/10.26452/ijprls.v9i1.1397

Production and Hosted by

ScienzTech.org

INTRODUCTION

In the shape of tablets, tubes, pills, creams, ointments, oils, aerosols, injections and suppositories as carriers, the treatment of an acute or recurrent illness has been carried out for several decades by supplying medicine to patients. It is important to take these formulations many times a day to ensure the optimal effective drug dosage in the bloodstream. This results in dosage dose volatility and undesirable toxicity. This has contributed to a growing interest in managed delivery systems [1] for medicines.

In spite of the undesirable side effects of prescription medications, the safest possible options for curing any illness are known to be natural medicines. Recommendations on herbal products are growing these days and the need for a generic product for which its effectiveness is predictable and reproducible is increasing in these markets. Novel drug distribution has been introduced to distribute generic herbal drugs in order to potentiate the action of the herbal drugs. In regards to this, several experiments have been carried out in the course to successfully extend the novel delivery of medications to herbal drugs.

In different experiments, lipid-based drug delivery systems have been studied and have demonstrated their ability to regulate the release and targeting of drugs. Better biopharmaceutical properties are imparted to the medication through pharmacosomes, resulting in enhanced bioavailability. Phytosomes, novel compounds composed of lipophilic herbal drug complexes, have been shown to be effective in enhancing drug delivery. These are modern types of traditional herbal medicines which have enhanced pharmacokinetic and pharmacological properties, and can be beneficially used to treat

acute diseases [2] . Phytosomes of phospholipid drugs have been developed [3] . Microcapsules have been prepared by layer-by-layer adsorption of carrageenan and oligochitosan into micro-particles of calcium carbonate in the treatment of gastric ulcers [4] . In view of these advantages of drug distribution, the present study was carried out to integrate Lycopene into mucoadhesive sodium alginate, carbopol 934 and sodium CMC microcapsules and to test their physicochemical parameters.

EXPERIMENTAL METHODOLOGY

Chemicals and m aterials

Lycopene was purchased from Sigma Aldrich, USA. All the polymers and reagents have been procured form SD Fine Chem Ltd, Mumbai. The chemicals and reagent used were of analytical grade.

Standard plot

As part of the preformulation experiments, the typical plot of Lycopene in 0.1 N HCl was spectrophotometrically drawn at concentrations 5, 10, 15, 20 and 25μg/ml (UV-Visible-1700, Shimadzu spectrophotometer) at 271 nm, resulting in a straight line with a r2 value of 0.997.

Formulation of microspheres

Mucoadhesive microspheres filled with lycopene is prepared by orifice ionic gelation with sodium alginate, carbopol 934 and sodium CMCC variations (carboxy methyl cellulose). Briefly weighted amounts of polymers and lycopene according to table 1 were distributed in 10 ml of distilled water with continuous stirring at 300 rpm for 30 min. A drop-wise syringe (17 guage) with a needle was applied to the resulting dispersion into 10% calcium chloride solution. The microspheres thus formed were held for 30 min for full treatment and then the microspheres were recovered by filtration through a sintered glass filter, dried in a hot air furnace at 500C for 1 hour.

Evaluation of microspheres

The evaluation of prepared microspheres was done as follows [5]

Percentage yield

The prepared microspheres were evaluated for percentage yield as per the equation,

% yield = Weight of microspheres recovered / Total weight (Drug + Polymer) $\times$ 100

Scanning electron microscopy (SEM)

SEM research was carried out using a scanning electron microscope (LEO, 435 VP, U.K.) to assess the surface morphology. Samples were placed on an aluminium stub using a double-sided adhesive tape prior to inspection and rendered electrically conductive by vacuum coating with a thin layer of gold (approximately 20 nm). At an acceleration voltage of 5 kV and a resolution of 4000, the scanning electron microscope performed.

Drug entrapment efficiency (DEE)

Microspheres filled with medications (100 mg) were powdered and suspended in a 0.1N HCl solution of 100 ml. For absolute mixing with continuous agitation, the resulting dispersion was stored for 24 hrs and filtered through a 0.45 μm membrane filter. Using the traditional drug graph (r2 = 0.997), the drug content was determined. The utility of drug entrapment (DEE) was defined by the equation,

DEE = (Pc / Tc) $\times$ 100,

Where, Pc is practical content, Tc is the theoretical content.

Percentage moisture loss

The microspheres filled with the medication were tested for a percentage loss of moisture that shares an idea of its hydrophilic nature. The microspheres were initially weighed (W1) and held in a desiccator containing calcium chloride for 24 hours at 370C. They were weighed and the procedure continued until no further improvement in the sample weight was found. It noticed the final weight (W2).

Moisture loss = $[(W_1 - W_2)/ W1] \times 100$.

Determination of swelling property

Microspheres of known weight were placed in dissolution solution (0.1N HCl) for 6 hr and the swollen microspheres were collected by centrifugation and the wet weight of the swollen microspheres was determined by blotting the particles with filter paper to remove absorbed water on surface and then weighing immediately on an electronic balance. The percentage swelling of microspheres in the dissolution media was then calculated by using equation,

Sw = [(Wt- Wo)/Wo] $\times$100

Where, Sw= percentage swelling of microspheres, Wt = weight of the microspheres after swelling, Wo = initial weight of the microspheres.

Mucoadhesion test

One of the appropriate methods for measuring the mucoadhesion ability of mucoadhesive particulate structures such as mucoadhesive microspheres & suspensions is the dropping film process. A fixed number (N1) of a sample of microspheres (100

Table 1: Preparation of microspheres

Formulation	Lycopene (mg)	Sod. Alginate (mg)	Carbopol (mg)	Sod CMC (mg)	% yield
F1	400	200	50	50	74.3±0.84
F2	400	200	75	25	93.98±0.51
F3	400	200	25	75	91.69±0.58
F4	400	150	50	100	87.76±0.58
F5	400	150	100	50	85.56±0.67

Table 2: Physicochemical properties of microspheres

Formulatior	In vitro muco-adhesion	Drug entrapment	Swelling index	Moisture loss
F1	87	96.364±0.21	69.43±0.56	6.1±0.18
F2	89	97.821±0.36	73.68±0.29	8.4±0.7
F3	91	98.719±0.47	71.52±0.35	5.3±0.11
F4	88	95.492±0.94	54.01± 0.82	7.9±2.5
F5	83	96.153±0.08	78.15±0.47	10.0±2.1

microspheres) [6] was scattered over a new intestinal section of the sheep, placed on a tilted slide at

an angle of 450, and allowed to incubate for 15 minutes. The 0.1N HCl solution was run steadily over the section at a flow rate of 1ml/min for 3 hours [7] . In a Whattman filter pad, the effluent was collected and the number of disconnected microspheres (N2) noted. The mucoadhesion percentage was determined by using the equation

% Mucoadhesion = $N_1 - N_2 / N_1 \times 100$

In vitro drug release

The in vitro release from microspheres of Lycopene has been determined [4, 6, 8]. In the USP basket style dissolution test apparatus, an in vitro drug release analysis was conducted. Microspheres were placed in a dissolution vessel basket containing 900ml of 0.1N HCl held at (37±1)0C and agitated at 100 rpm. At an interval of 1 hour, sample liquotes (5 ml) is extracted and filtered through the whatman filter paper. Sink state with the dissolution medium was preserved.

RESULTS AND DISCUSSION

Following the table 1, five formulations had been prepared and evaluated. Prepared microspheres are subjected to the evaluation of Percentage yield, Drug entrapment, moisture loss, muco-adhesion strength, swelling index, in vitro drug release and in vivo antiulcer activity and the results were tabulated. The percentage yield of all the formulations had been evaluated and formulation F2 showed the highest percentage yield of 93% followed by F3 which is 90% also significantly similar to F2. In contrast the drug entrapment efficiency of the formulation F3 leads F2 with 96.691 and 95.611 respectively [Table 1].

Using S.E.M, the prepared microspheres were examined for particle structure and surface morphology. Each microsphere, on average, measures about 700μm in diameter. In type and with a flat base, it is approximately spherical. As is apparent from the lack of cracks and folds on the paper, the microspheres were adequately dried. Microsphere splitting revealed an equal distribution of the compound. The swelling indices for high-carbopol to CMC ratio formulations is high compared to low-ratio formulations. It shows that carbopol is responsible for water absorption and swelling.

It is clear that F5 had the highest swelling index of 77 percent, which had a high carbopol content, and as suggested, F3 may unexpectedly have the least swelling index, because of the low sodium alginate concentration, F4 swelled less. This confirms the swelling effect of sodium alginate. The percentage values of moisture depletion of all formulations are subject to limitations. Compared to all formulations, Formulation F3 displayed a lower benefit. It can also be confirmed that the mixture is sufficiently dry and that the carbopol material also influences the amount of moisture in the microspheres as seen by their swelling indices [Table 2].

Using the dropping film process, the in vitro mucoadhesion test was carried out. F3 had the maximum muco-adhesive power with a value of 89, followed by F2 with a value of 86. With formulation F5, the

least value was found. It can be concluded from both values that the presence of Sodium CMC affects muco-adhesion. The higher the sodium CMC content, the greater the muco-adhesion is. But sodium alginate also has a strong muco-adhesion property that can be verified by comparing the volume of sodium CMC with differing amounts of sodium alginate that have demonstrated improved adhesion to F1 when formulations F1 and F5 are compared. Sodium alginate is a favored encapsulating agent that facilitates the muco-adhesion of sodium CMC [Figure 1].

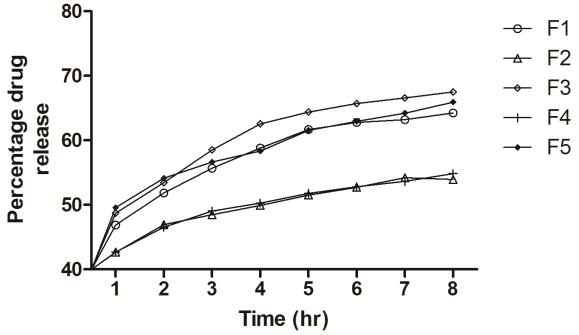

Figure 1: Drug release studies of lycopene from microspheres

This means that both the form of polymer used in the preparation of microspheres and their concentration affect the potential of muco-adhesion. Overall, strong muco-adhesion ability was seen by all formulations and is obvious from table 2. The release is scheduled to last for a further 4 hours. Overall, by inserting the Lycopene drug into the muco-adhesive microcapsules, a drug release lasting up to 12 hours can be obtained.

CONCLUSION

In spite of the limitations of herbal formulations, the introduction of herbal medications into polymers is of great concern and the adoption of NDDS for their distribution will ideally enhance the consistency of treatment for every illness. The integration of herbal medicines into muco-adhesive microspheres for the treatment of diseases, especially gastric ulcers, is a welcome development for research in the field of gastro-retentive drug delivery systems for the delivery of herbal medicines. This could result in formulations that meet patient compliance with continuous release and improved effectiveness that also limits the side effects. In the other hand, the main concern to be considered is the standardization of herbal medicines intended for NDDS. The rate-limiting step for research in this regard is proper chemo-profiling and limiting pesticide and heavy metal toxicity.

ACKNOWLEDGEMENTS

The authors are thankful to all who have extended their constant support for the completion of the work.

Funding Support

The authors declare that they have no funding support for this study.

Conflict of Interest

The authors declare that they have no conflict of interest for this study.

REFERENCES

[1] Chien YW. Concepts and System Design for Rate-controlled Drug Delivery. Novel Drug Delivery System. 1992;p. 139–196.

[2] Jain N, Valli K, Devi V. Importance of novel drug delivery systems in herbal medicines. Pharmacognosy Reviews. 2010;4(7):27–27. Available from: 10.4103/0973-7847.65322.

[3] Semalty A, Semalty M, Rawat BS, Singh D, Rawat MSM. Pharmacosomes: the lipid-based new drug delivery system. Expert Opinion on Drug Delivery. 2009;6(6):599–612. Available from: 10.1517/17425240902967607.

[4] Borodina TN, Rumsh LD, Kunizhev SM, Sukhorukov GB, Vorozhtsov GN, Feldman BM, et al. Entrapment of herbal extracts into biodegradable microcapsules. Biochemistry (Moscow) Supplement Series B: Biomedical Chemistry. 2008;2(2):176–182. Available from: 10.1134/s199075080802008x.

[5] Harborne JB, Methods, London. Phytochemical Methods. A Guide to Modern Techniques of Plant Analysis. SpringerLink. 1998;Available from: https://link.springer.com/book/10.1007/978-94-009-5570-7.

[6] Wagner H, Bladt S. Plant Drug Analysis. A Thin Layer Chromatography Atlas. Springer. 1996;Available from: https://www.springer.com/gp/book/9783642005732.

[7] Bhabani SN, Sunil KG, Tripati K, Patro B. Preparation and characterization of famotidine microcapsule employing mucoadhesive polymers in combination to enhance Gastro retention for oral delivery. Int J Pharm Pharm Sci. 2009;1(2):209–209.

[8] Arya RKK, Singh R, Juyal V. Mucoadhesive microspheres of famotidine: preparation characterization and in vitro evaluation. Int J Eng Sci Tech. 2010;2(6):1575–80.

Cite this article: D Jeslin, P Panneerselvam, G Vijayamma, Y Suryasree, T Siddeswari, K Nithyakalyani. **Novel drug delivery system of Lycopene: Preparation and *in-vitro* investigation**. Int. J Pharm. Res. Life Sci. 2021; 9(1): 1-5.