Preparation of Aspirin Loaded Ethyl Cellulose Nanoparticles by Nano Precipitation Technique

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Abstract

The aim of the present investigation is to prepare aspirin loaded ethyl cellulose nanoparticles by Nano precipitation technique. The obtained nanoparticles were evaluated for product yield, drug content, and entrapment efficiency and loading capacity. The drug content was found to be 90%. The entrapment efficiency and loading capacity were observed as 77.82% and 78.9% respectively. The SEM image clearly indicates the formation of nanoparticles.

Introduction

Nanotechnology is the design, characterization, synthesis and application of materials, structures, devices and systems by controlling shape and size at nanometer scale [1, 2]. The major goals in designing polymeric nanoparticles as a delivery system is to control particle size, surface properties and release of pharmacologically active agents in order to achieve the site-specific action of the drug at the therapeutically optimal rate and dose regimen. Nanoparticles are defined as particulate dispersions or solid particles with a size in the range of 10-1000nm.Due to large surface to volume ratio, the nano-scale structures have unique properties and dissolution behaviors which are expected to avoid the unwanted side effects. The rate of dissolution of a drug is a function of its intrinsic solubility and its particle size. Studies with poorly soluble drugs have demonstrated that particle size reduction to the sub micron range can lead to an increase in dissolution rate and higher bioavailability [3, 4]. At present approximately 60% of the drugs synthesized are poorly soluble in nature. This increasing number of poorly soluble drugs requires innovative formulation approaches to sufficiently reach high bioavailability after oral administration. Nowadays, Nanonisation was widely employed for BCS Class II drugs i.e. drugs having high permeability but low oral bioavailability due to their poor solubility and low dissolution velocity. The principle of Nanonisation was to increase the dissolution velocity and their by enlarging the surface area of drug powder [5, 6].

Aspirin is a non-steroidal anti-inflammatory drug used to decrease stiffness of the spine and other joints. Ankylosing spondylitis (AS) is a form of chronic inflammation of the spine and the sacroiliac joints. The sacroiliac joints are located in the low back where the sacrum (the bone directly above the tailbone) meets the iliac bones. Chronic inflammation in these areas causes pain and stiffness in and around the spine. In the treatment of AS and arthritis the dose of aspirin required is 3 g/day in divided doses. As there are more chances of missing the dose of drug it is better to formulate sustained release dosage forms for better administration. Aspirin acts by inhibiting Cox1 and Cox2 receptors. By inhibiting Cox1 it causes severe Gastro intestinal bleeding and peptic ulcers. By inhibiting Cox2 it causes severe cardiovascular problems. To reduce the side effects, dose and dosing frequency a study was made to prepare aspirin nanoparticles [7, 8].

This technique involves the use of a semi polar organic solvent that is completely miscible with the aqueous phase, typically (acetone, ethanol or methanol). In this case, the polymer precipitation is directly induced in an aqueous medium (non solvent), by progressive addition under stirring of the polymer solution. This method is limited to drugs that are highly soluble in polar solvents. This method has been applied to various polymeric materials such as PLGA, PLA, PCL, and poly (methyl vinyl ether-co maleic anhydride) (PVM/MA).

Advantages: This technique is very simple, does not involve use of high homogenizers and hence can be easily scaled up easily in an industrial step.

Disadvantages: A major drawback of this technique is the difficulty to choose drug/polymer/solvent/non solvent in which nanoparticles are formed and the drug is efficiently entrapped.

Materials and Methodology

Aspirin and Ethyl cellulose were obtained from S.D Fine Chemicals. Pvt.Ltd. Acetone was supplied by S.D Fine Chemicals. Pvt. Ltd.

Experimental methodology

For the preparation of aspirin nanoparticles Nanoprecipitation technique was adapted. Drug and polymer were dissolved in Acetone and sonicated for 10-15 minutes. The drug-polymer solution was added drop by drop in to 0.6% PVA solution under continuous mechanical stirring at 700 rpm. Spontaneous precipitate formation can be observed. After 4hrs of continuous stirring the solvent from the resultant precipitate is removed by rotary evaporation. Free flowing amorphous nanoparticles were obtained [9, 10]. (Figure 1)
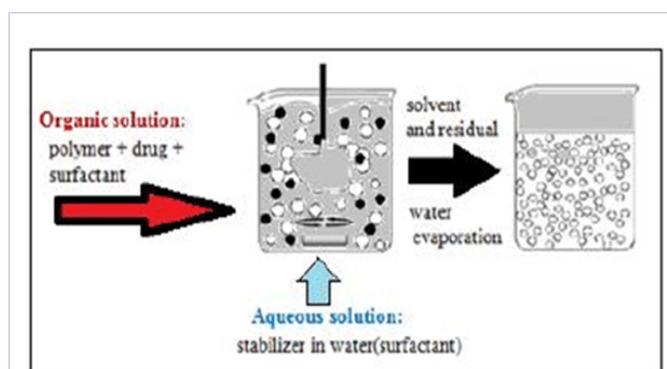
Figure 1: Schematic diagram representing nanoprecipitation technique

Results and Discussion

1) Drug-polymer interaction

2) Surface morphology studies using SEM

3) Drug content

4) Entrapment efficiency

5) Loading capacity

1) Study of surface morphology of nanoparticles by scanning electron microscope (SEM)

The prepared amorphous nanoparticles were dispersed in deionized water and sonicated for 30 minutes. A circular metal plate is taken on to which carbon double tape (1mm×1mm) is stickered; a drop of the resultant nano dispersion is placed on to the tape and allowed to dry for a while. Then it is scanned under SEM for morphology [11, 12]. (Figure 2)
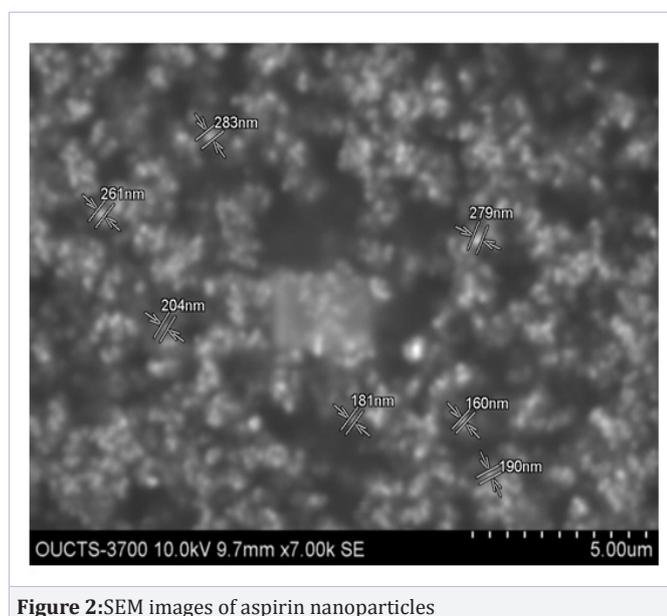

Figure 2: SEM images of aspirin nanoparticles

1) Drug content: A known amount of Drug loaded nanoparticles were weighed, then grinded to fine powder and dissolved in a solvent in which the drug is completely soluble i.e, methanol. It was subjected to stirring at 700 rpm for 3 hrs. Amount of drug in the supernatant was determined by UV-Spectrophotometric method [13, 14].

The drug content was observed to be 90±3%

2) Entrapment efficiency: The nanoparticles formulations were examined for entrapment efficiency. Entrapment efficiency was conducted by taking prepared particles in equivalent quantity of pH 7.4 phosphate buffers [15, 16]. The nanoparticles suspension is ultra-centrifuged at 17240rpm and temperature of -4°C for 40 minutes. The entrapment efficiency can be expressed as follow; the loading capacity was calculated by using the following formula [17].

$$\text{Entrapment Efficiency} = \frac{\text{Total amount of the drug entrapped}}{\text{Total amount of the drug initially taken}} \times 100$$

$$\text{Loading Capacity} = \frac{\text{Total amount of the drug entrapped}}{\text{Total weight of the nano particles taken}} \times 100$$

The entrapment efficiency and loading capacity of aspirin loaded ethyl cellulose nanoparticles were observed as 77.82% and 78.9% respectively.

Conclusions

Aspirin loaded ethyl cellulose nanoparticles were prepared by Nano precipitation technique. Process parameters such as stirring speed, stirring time were optimized. The obtained nanoparticles were characterized by Scanning electron microscopy. The images clearly reveal that the particles were in nano range. The drug content was found to be 90±3%. The entrapment efficiency and loading capacity of aspirin loaded ethyl cellulose nanoparticles were observed as 77.82% and 78.9% respectively. Further studies have to be performed to determine the percentage of drug release.

References

1. Mora-Huertas CE, Fessi H, Elaissar A. Influence of process and formulation parameters on the formation of submicron particles by solvent displacement and emulsification- diffusion methods critical comparison. Advances in colloid and interface science. 2011; 163(2):90-122.

2. Mora-Huertas E, Fessi H, Elaissari A. Polymer based nanocapsules for drug delivery. International journal of pharmaceuticals. 2010;355(1-2):113-142.

3. Loveleen Preet Kaur, Tarun Kumar Guleri. Topical Gel: A Recent Approach for Novel Drug delivery. Asian Journal of Biomedical and Pharmaceutical Sciences 2013;3(17):1-5.

4. Sanjay J Kshirsagar. Nanoparticle for colon specific drug delivery system. International conferences on nanotech and expo. 2013.

5. Laxmi Banjare, Narendra Ghillare. Development of biocompatible nanoparticles for sustained topical delivery of Rutin, International Journal of Pharmaceutical & Biological Archives. 2012;3(2):326-332.

6. Sneha sahu, Swarnlatha saraf, Chanchaldeep kaur, Shailendra seraf. Biocompatible nanoparticles for sustained tropical delivery of anti cancer phyto constituent Quercetin, Pakistan journal of biological sciences. 2013;16(13):601-609.

7. A.Krishna sailaja, Amareshwar P. Preparation of chitosan coated nanoparticles by emulsion polymerization technique. Asian journ al of pharmaceutical and clinical research. 2011;4(1):73-74.

8. Prathima Srinivas, Sreeja K. Formulation and Evaluation of Voriconazole Loaded Nanosponges for Oral and Topical Delivery Int. J. Drug Dev. & Res. 2013;5(1):55-69.

9. Rachit Khullar, Deepinder Kumar, Nimrata Seth, Seema Saini. Formulation and evaluation of mefenamic acid emulgels for topical delivery, Saudi Pharmaceutical Journal. 2012;20:63-67.

10. Krishna sailaja A, Sarita A. Preparation and characterization of Aspirin loaded ethyl cellulose nanoparticles by solvent evaporation technique. 2014. World Journal of pharmacy and Pharmaceutical Sciences. 2014;3(6):1781-1793.

11. Ki Chang Song a, Ho Seok Lee a, Il Yeop Choung a, Kyung In Cho a, Yangkyu Ahn b and Eun Jung Choi. The effect of type of organic phase solvents on the particle size of poly (d,l-lactide-co-glycolide) nanoparticles. Colloids and Surfaces A: physicochem, Engg. 2006;276(1):162-167.

12. Md. Khalim Anwer. Development of Diosmin loaded Eudragit®S100 polymeric nanoparticles: an investigation on antioxidant effect. International journal of biology, pharmacy and allied sciences. 2014;3(8):2015-2026.

13. Jawahar N, Eagathappanath T, Nagaswamy Venkatesh, Jubie S, Samanta MK. Preparation and Characterisation of PLGA-Nanoparticles containing an Antihypertensive agent. International Journal of PharmTech Research. 2009;1(2):390-393.

14. Sarita Kumari Yadav, Shivani Mishra, Brahmeshwar Mishra. Eudragit-Based Nanosuspension of Poorly Water-Soluble Drug: Formulation and In Vitro–In Vivo Evaluation. AAPS PharmSciTech. 2012;13(4):1031-1044.

15. Laxmi B, Narendra Ghillare. Development of biocompatible nanoparticles for sustained topical delivery of rutin. International journal of pharmaceutical & biological Archives. 2012;3(2):326-332.

16. Sahu S, Saraf S, Kaur CD. Biocompatible nanoparticles for sustained topical delivery of anticancer phytoconstituent quercetin. Pak J Biol Sci. 2013;16(13):601-609.

17. Morgen M, Corey Bloom, Ron Beyerinck. Polymeric nanoparticles for increased oral bioavailability and rapid absorption using celecoxib as model of a low-solubility, high permeability drug. Pharm Res. 2012;29(2):427-440.