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Application of Polyvinylpyrolidone Nanofibers in Enhancement of Solubility of Glibenclamide Drug

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ABSTRACT *Nanofibers made from polyvinylpyrolidone (PVP) can be used for the enhancement of the solubility of the insoluble or poorly water soluble drugs like Glibenclamide. The solubility of the drug is very important in pharmacokinetics for taking effect. The polyvinylpyrolidone is an n-vinyl polymer which is hygroscopic in nature and absorbs water immediately and mix with the water. Glibenclamide is an important drug in the type II diabetes. Nanofibers are helpful in the solubility of drug. The nanofibers are used for this purpose because these are very fragile and porous in nature and can be easily soluble. The Electrospin machine is used for the production of the nanofibers in which the PVP and the well mixed solution of the drug is used for the production of the Glibenclamide incorporated PVP nanofibers. Nanofibers are characterized using scanning electron microscope. The rate of dissolution is carried out using the dissolution apparatus. The nanofibers are helpful for increasing bioavailability of Glibenclamide drug.*

INTRODUCTION

Nanofiber production is carried out by using electrospinning machine. In this machine two electrodes are used separated or placed at a longer distance from each other. One electrode carries positive charge at which the polymer solution is loaded and another is negative electrode which is joined to drum collector which collects the nanofibers on a coated aluminium foil. The collected nanofibers are characterized using scanning electron microscope. Almost any soluble polymer with sufficiently high molecular weight can be electrospun. (Seeram Ramakrishna *et al.*, 2006).

Polyvinylpyrrolidone (PVP), also commonly called Polyvidone or Povidone, is a water-soluble polymer made from the monomer *N*-vinylpyrrolidone (F. Haaf et al, 1985). It is used as a binder in many pharmaceutical tablets (Bühler and Volker, 2005)

Glibenclamide is chemically known as 5-chloro-N-[2-[4[(cyclohexylamino) carbonyl] amino] sulfonyl] phenyl] ethyl]-2-methoxy benzamide is second generation sulphonyl ureas drug widely used in treatment of type II diabetic patients. It acts by inhibiting ATP-sensitive potassium channels in pancreatic beta cells causing cell membrane depolarization (increasing intracellular calcium in the beta cell) which stimulates the insulin release (K. Parameswararao *et al.*, 2012).

MATERIALS AND METHODS

Production of Nanofibers

The drug is obtained in pure form (Samruddha Pharmaceuticals, Thane, Mumbai, India) and dissolved 0.4gm in 3ml of chloroform and 1ml of methanol (10%) The clear transparent solution is made having no crystals. PVP (Sigma Aldrich Chemicals, Germany) is dissolved 1gm in 10ml methanol (10%). For production of the nanofibers 3ml of dissolved PVP and 1ml of dissolved Glibenclamide is mixed and formulation is loaded in 2ml of hypodermic syringe in the electrospin machine (Espin-nano, Zeonics Systech, PECO-Chennai, India). 10 cm distance kept between needle and collector drum, 2ml syringe, 12kV voltage, 1 ml/ hr speed of the spraying the solution and 2000rpm speed of the collecting drum. The samples are checked through the scanning electron microscope.

Characterization

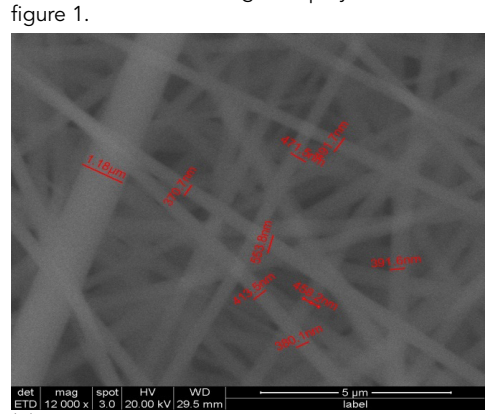
The external surface morphology and diameter of nanofibers were studied by SEM. The nanofibers were observed under a scanning electron microscope (FEI Quanta 200, Indian Institute of Science, Bangalore). They were mounted directly on to the SEM sample stub using double-sided sticking tape and coated with gold film (thickness 200 nm) under reduced pressure (10−4 mm of Hg).

In vitro dissolution studies

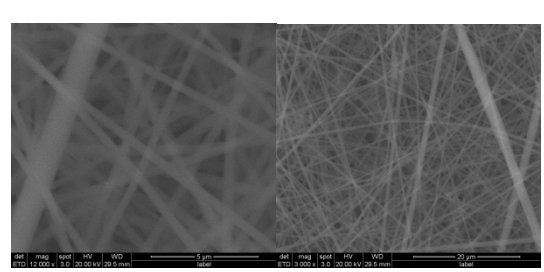
For in vitro dissolution studies dissolution apparatus 8000 is used. (LabIndia, Mumbai). The rate of Glibenclamide released from electrospun nanofibers was studied in phosphate buffer of pH 7.2 and at temperature 37°C and at 30 rpm in basket type.

RESULTS

The nanofibers are made. Uniform fibers were obtained with average diameter of 300-400 nm. Glibenclamide crystals were not detected by electron microscopy, indicating uniform distribution of drug and polymer solution, as seen in figure 1.



(a)



(b) (c)

Fig: 1: (a,b,c)Photograph of PVP + Glibenclamide using scanning electron microscope (FEI Quanta 200, Indian Institute of Science, Bangalore).

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The nanofibers are dissolved in phosphate buffer pH 7.2. Basket method is used for dissolution of nanofibers. In the bowel in which the drug nanofibers were kept the water started to become white after 17 min and after 2 hrs the clear solution of the nanofibers was obtained. The water became slightly white because complete dissolution of the plyvinylpyrolidone nanofibers containing glibenclamide drug. In another bowel in whch pure drug was kept, the drug was still inside, some amount of the drug was found at the bottom of the bowel.

CONCLUSION

The nanofibers are dissolved properly than the pure drug. So the nanofibers can be applied for the increasing enhancement of the poorly soluble drugs.

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