Abstract

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Title of Doctoral Thesis: Nanofibrous membranes as drug delivery systems

Nowadays, nanofibrous membranes are very quickly developing systems with proportions in nanometre scale. They are intensively studied and used in many technical disciplines, mostly thanks to their unique properties, among them great surface area to volume as a highlight. Their use in the field of biomedicine and pharmacy as drug delivery carriers, wound dressings and tissue engineering scaffolds is currently a topic of great interest.

The doctoral thesis deals with newly formulated drug loaded nanofibrous membranes made of several selected polymers with diverse properties produced by electrospinning technology for large-scale production. The purpose was an experimental investigation and demonstration of potential benefits from application of nanofibrous membranes to selected application sites and dosage forms.

The prepared membranes were evaluated by scanning electron microscopy and differential scanning calorimetry that proved successful incorporation of the drugs into the structure of the polymeric nanofibers. Moreover the measurements proved that the drugs are fixed inside polymeric fibres in a non-crystalline state, as amorphous or molecular dispersions.

The drug release experiments were conducted using buffered solutions mimicking basic conditions of sublingual or oral administration. The obtained results showed significant differences in the drug release rate, depending the most on the polymer used as a carrier. Membranes made of hydrophilic polymers released drugs very quickly that is why hydrophilic polymers were selected for formulation of membranes for sublingual administration of sumatriptan and naproxen. Both the drugs were successfully incorporated into the structure of nanofibres separately and in their combination too. *In vitro* permeation studies using a porcine sublingual mucosa showed improvements in the permeation rate of

both of the drugs, when the nanofibrous carrier was used as the donor comparing to drug solutions.

Very important finding from practical point of view was achieved in the dissolution studies of the poorly water-soluble drug diosmin. Incorporation into polymeric nanofibres by electrospinning resulted in a great dissolution improvement. The experiments conducted in buffered solutions, simulating intestinal pH, showed significantly higher levels of the dissolved drug compared to powdered and micronized drug forms. The following *in vivo* bioavailability study performed on rats resulted in improved pharmacokinetic parameters of nanofibrous drug carrier in comparison with commercially available micronized drug dosage form.

The results obtained in the study broaden the knowledge and prove the suitability of nanofibrous membranes for the formulation of drug delivery carriers. The most suitable applications are novel mucosal – sublingual preparation and oral dosage form with improved dissolution of poorly soluble drugs.