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'This thesis is the result of the author's original research. It has been composed by the author and has not been previously submitted for examination which has led to the award of a degree.'

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Abstract

Myxospermous seeds are characterised by the secretion of mucilage around the seed during germination. *Capsella bursa-pastoris* is an annual or perennial herbal plant of Brassicaceae family which has myxospermous seeds. This thesis studied extracted *Capsella bursa-pastoris* mucilage to see if it could be employed as a drug delivery system targeting the nasal cavity.

Firstly, different extraction methods were used to extract the mucilage from Shepherd's purse seeds without other contaminating components present from the seed coat. The extraction methods included the use of different solvents and temperatures. The extracts were freeze dried and underwent extensive studies of their physical (moisture content, glass transition temperature) and chemical (degree of esterification, carbohydrate composition) characteristics to compare them. Physicochemical properties of mucilage were studied using different approaches to understand the mucilage behaviour and assess its ability to be developed into a drug delivery system. The colorimetric identification of mucilage components, found rhamnose and uronic acid, which was indicative of extraction of a pectic type polymer. Fourier Transform Infra-Red (FTIR) examination of the different samples of mucilage suggested that the polymer was a polygalacuturonic acid. These findings were supported by Nuclear Magnetic Resonance (NMR) findings of an uronolactone structure which was predicated from intramolecular esterification of the uronic acid to form a lactone ring. The vapour sorption ability of mucilage was measured by DVS and was found to be huge and capable of adsorbing 50-70% of its weight accompanied with crystallisation at temperature below room temperature (17°C) and relative humidity as low as 10% assessed by Differential Scanning Calorimetry (DSC). Mucilage was thermally unstable and lost its adsorbed moisture at 40°C when it was heated in Thermo-Gravimetric Analysis (TGA). The different solvent extractions produced extracts with similar characteristics. All extracts were further examined for their mucoadhesion characteristics using Atomic Force (AFM) spectroscopy.

An AFM study of the mucoadhesion of the mucilage to mucin coated mica sheets showed that the mucoadhesion power of extracted mucilage to mucin was higher than that of standard pectin and hydroxylpropylmethyl celluloses K100 which are widely used for drug delivery. It seemed that the mucilage would be a good candidate for a drug delivery system to the nasal cavity due to its mucoadhesive property.

After assessing the physicochemical properties of all mucilage extracts and their mucoadhesion ability, water maceration extract was chosen for the development of the drug delivery system. Paracetamol and amitriptyline were chosen for their solubility properties as drug models. Different dosage forms with different surface areas were formed using the mucilage and the chosen drugs. Drug release properties from the different forms (discs and inserts) were assessed using Franz cells of diffusion. Shepherd's purse mucilage was successfully formed into a drug delivery form able to deliver drugs to the site of administration by the effect of a plasticiser. Additionally, the mucilage drug delivery system was able to take up and release drugs. However, % paracetamol released from the mucilage inserts was not different from the % released from HPMC K100. The calculated similarity factor of the release profile of amitriptyline from mucilage and HPMC K100 nasal inserts was 43.5. Furthermore, the similarity factor of amitriptyline release from nasal discs of mucilage and HPMC K100 was 59.6. The drug delivery system from mucilage was as effective as HPMC K100 in drug release profile. The developed drug delivery system was able to adhere to mucin stronger than HPMC K100 and commercial available standard pectin; however, the pseudoplastic behaviour of the mucilage used to develop the system would lead to reduction of the viscosity of the system upon application. It is expected that as a result the drug delivery system could be washed out of the nasal cavity before delivering its drug content.

Further drug delivery studies are required using *ex vivo* and *in vivo* methods to assess its suitability for developing a new drug delivery system. Nevertheless, the results presented in this thesis show that the mucilage could be a viable nasal drug delivery system and worthy of further investigation.

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Thermogravimetry (TGA)

Differential scanning calorimetry (DSC)

Polyethylene glycols (PEG

Rhamnogalacturonan I (RGI),

Homogalacturonan (HG),

Rhamnogalacturonan-II (RGII),

Degree of esterification (DE)

Area under the curve (AUC)

Fourier Transform Infra-Red (FTIR)

Dynamic Vapour Sorption (DVS)

% Relative Humidity (RH%)

Glass Transition Temperature (Tg)

Nuclear Magnetic Resonance (NMR)

1H-1H correlation spectroscopy (COSY)

Heteronuclear single-quantum correlation spectroscopy (HSQC)

Total correlation spectroscopy (TOCSY)

Multi Bond Coherent Spectroscopy (HMBC)

Hydroxypropyl methylcellulose (HPMC)

Atomic force microscopy (AFM)

Simulated nasal electrolyte solution (SNES)