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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 polygalacturonic 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 hydroxypropylmethyl 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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Table of Contents

Declaration.....	i
Abstract.....	ii
Acknowledgements	v
Table of Contents.....	vi
List of Figures.....	x
List of Tables.....	xiii
List of Abbreviations.....	xv
Chapter 1Background and general introduction.....	1
1.1 Introduction to Nasal Drug delivery	1
1.2 Nasal dosage forms	4
1.2.1 Liquid nasal solutions	5
1.2.2 Powder dosage forms	5
1.2.3 Pressurised Metered-Dose Inhaler (MDI)	6
1.2.4 Nasal gels	6
1.3 Anatomy and physiology of the nose	7
1.4 Bioadhesion	9
1.5 Polymers in drug delivery	10
1.6 Capsella bursa-Pastoris	12
1.6.1 Taxonomic Hierarchy	14
1.6.2. Plant Description	15
1.6.2.1. Leaf Morphology.....	15
1.6.2.2 Stem Morphology.....	16
1.6.2.3 Flowers Morphology.....	17
1.6.2.4 Seeds Morphology.....	18
1.6.2.5 Root Morphology.....	20
1.7 Phytochemical composition of Capsella seeds	21
1.8 Seed coat development and mucilage release	23
1.9 Project Aims.....	25

Chapter 2	Extraction and physiochemical characterisation of Shepherd's purse seed mucilage.....	28
2.1.	Introduction.....	28
2.1.1	Physicochemical properties characterisation.....	30
A.	Colorimetric assays.....	30
B	Fourier Transform Infra-Red Spectroscopy.....	31
C	Dynamic Vapour Sorption (DVS).....	32
D	Thermal analysis.....	33
E	Nuclear Magnetic Resonance Spectroscopy.....	35
2.2.	Aims	36
2.3.	Materials and methods	37
2.3.1.	Material and Equipments	37
2.3.2.	Methods	38
2.3.2.1	Extraction.....	40
2.3.2.1.1	Water maceration.....	40
2.3.2.1.2	Solvent maceration.....	40
2.3.2.1.3.	Hot reflux	41
2.3.2.1.4	Hot maceration.....	41
2.3.2.2	Freeze drying extracted mucilage.....	41
2.3.2.3	Characterisation tests.....	43
2.3.2.3.1.	Galacturonic acid and carbohydrate identification.....	43
2.3.2.3.2.	DE using FTIR.....	44
2.3.2.3.3.	Dynamic Vapour Sorption (DVS) analysis.....	44
2.3.2.3.4.	Thermal screening.....	46
A.	TGA analysis.....	46
B.	DSC analysis.....	46
2.3.2.3.5.	Determination of bound water.....	47
2.3.2.3.6.	Chemical structure elucidation using Nuclear Magnetic Resonance....	47
2.3.3.	Statistical analysis.....	48
2.4.	Results.....	48
2.4.1.	Carbohydrate identification and galacturonic acid content determination.....	48
2.4.2.	Degree of Esterification.....	48

2.4.3.	Dynamic Vapour Sorption	58
2.4.4.	Thermal analysis	65
2.4.4.1.	TGA.....	65
2.4.4.2.	DSC analysis.....	67
2.4.5.	Bound water measurement	70
2.4.6.	Chemical structure elucidation	72
2.4.6.1.	NMR spectra analysis for mucilage 70°C-2hr.....	72
2.4.6.2.	NMR spectra analysis for mucilage 50°C-1h.....	79
2.5.	Discussion.....	86
2.6.	Conclusion	97
Chapter 3 Mucoadhesion study of shepherd's purse mucilage.....		100
3.1.	Introduction.....	100
3.2.	Aims and Objectives.....	101
4.3.	Method and Material.....	102
3.3.1.	Material.....	102
3.3.2.	Sample preparation and analysis.....	102
3.3.3.	Statistical Analysis.....	104
3.4.	Results	104
3.5.	Discussion.....	109
3.6.	Conclusion.....	114
Chapter 4 Drug delivery system formulation and drug release studies.....		116
4.1.	Introduction.....	116
4.2.	Drug Release Behaviour using Franz Cells of Diffusion.....	116
4.3.	Aims and Objectives.....	119
4.4.	Materials and Methods.....	120
4.4.1.	Equipment and Materials	120
4.4.2.	Preparation of dosage form for diffusion studies.....	121
4.4.2.1.	Culture plates pre-treatment.....	121
4.4.2.2.	Formation of discs.....	122
4.4.2.3.	Formation of nasal inserts.....	122
4.4.2.4.	The use of plasticisers.....	123
4.4.3.	Formation of 1:2 drug-polymer ratio discs, and 1:3 drug-polymer ratio discs.....	124

4.4.4.	In vitro release studies using Franz cells of diffusion.....	124
4.4.4.1.	Testing the effect of plasticiser on drug release properties.....	125
4.4.4.2.	Studying the effect of surface area on the release properties of drug.....	125
4.4.4.4.	Analysis of samples from release studies.....	126
4.4.5.	Statistical analysis.....	126
4.5.	Results.....	126
4.5.1.	Preparation of dosage form.....	126
4.5.1.1.	Formation of discs.....	126
4.5.1.1.1.	Drug content measurement in the discs.....	127
4.5.1.2.	Formation of nasal inserts.....	128
4.5.1.2.1.	Drug content measurements in the inserts.....	129
4.5.1.3.	The effect of plasticiser on drug release.....	130
4.5.1.3.1.	Drug content measurements for mannitol contained discs.....	132
4.5.1.4.	Formation of 1:2 , and 1:3 ration.....	132
4.5.2.	In vitro release studies using Franz cells of diffusion.....	134
4.5.2.1.	The release profile of paracetamol from nasal inserts.....	137
4.5.2.2.	Amitriptyline release from nasal inserts and nasal discs.....	137
4.5.2.3.	Study the effect of mannitol on the drug release profile.....	139
4.6.	Discussion.....	140
4.7.	Conclusion.....	147
	Chapter 5 Rheological behaviour and viscosity measurements.....	149
5.1.	Introduction.....	149
5.2.	Aims and Objective.....	150
5.3.	Materials and Methods.....	151
5.3.1.	Materials and equipment.....	151
5.3.2.	Methods.....	152
5.3.2.1.	Apparent Viscosity measurement using viscometer.....	151
5.3.2.2.	Rheological behaviour.....	153
5.3.3.	Statistical analysis.....	154
5.4.	Results.....	154
5.4.1.	Apparent Viscosity measurement using viscometer.....	154
5.4.2.	Rheological study.....	155

5.5. Discussion.....	157
5.6 conclusion.....	160
Chapter 6 General conclusion and Future work.....	161
6.1. General Conclusion... ..	161
6.2. Future Work.....	166
References.....	168
Appendix A.....	187
Appendix B.....	192

List of Figures

Figure 1 1 Mechanism of drug permeation through the nasal epithelial membrane. A) trans-cellular passive diffusion, B) para-cellular passive diffusion, C) carrier-mediated transport, and D) absorption through transcytosis.....	2
Figure 1 2 Labelled nasal parts.....	9
Figure 1 3 Shephred's purse plant showing stem, basal leaves, inflorescence and flowers.....	16
Figure 1 4 Branched stem of Shepherd's purse.....	17
Figure 1 5 Inflorescence and seeds pods on branched stem of Shepherd's purse.....	18
Figure 1 6 Shepherd's purse seeds.....	19
Figure 1 7 Shepherd's purse roots.....	21
Figure 1 8 Shepherd's purse seeds immersed in water containing Ruthenium red and examined using light microscopy.....	25
Figure 2-1 Schematic diagram shows all pectin structures.....	29
Figure 2-2 Schematic diagram of all experiments used in this chapter.....	39
Figure 2-3. FTIR Spectra of standard pectin with known DE (A) 20-34% DE, (B) 34-46% DE,(C) 46-55% DE, (D)55-65% DE, (E) 61-70% DE Standard.....	52
Figure 2-4 The best fit line (A) Peak height against %DE for standard pectin, (B)AUC against% DE of standard pectin.	53
Figure 2-5 FTIR Spectra of mucilage extract, (A) hot maceration 40C-1hr, (B) hot maceration 40C-2hr, (C) hot maceration50°C-2hr, (D) hot maceartion50°C-1hr, (E) hot maceartion70°C, (F) solvent maceration, (G) water maceration, (H) hot reflex.....	56
Figure 2-6 DVS Chart shows changes in the Mass with changes in target RH% against for water maceration (WM) mucilage (n=1).....	59

Figure 2-7 DVS chart shows change in Mass with change in target RH% against time for HM 40°C-1hr (n=1).	60
Figure 2-8 DVS chart of change in mass with change in target RH % against time for hot maceration 40°C-2h (n=1).....	61
Figure 2-9 DVS chart of change in mass with change in target RH% against time for hot maceration mucilage (n=1) (A) 50°C-1h, (B) 50°C-2h, (C) 70°C	62
Figure 2-10 DVS chart shows change in Mass with change in target RH% against time for hot reflux mucilage extract	64
Figure 2-11 DVS chart shows change in Mass with change in target RH% against time for Solvent maceration (SM).....	65
Figure 2-12 TGA spectrum of shepherd's purse mucilage heated from 25°C to 300°C at 10°C/min	66
Figure 2-13 TGA spectrum of shepherd's purse mucilage heated from 25°C to 150°C at 10°C/min	67
Figure 2-14 DSC spectrum of mucilage WM.....	68
Figure 2-15 DSC spectrum of mucilage WM by quench-cool method.....	70
Figure 2-16 1H NMR spectrum of Capsella Mucilage 70°C-2hr in D2O at 400MHz with water suppression at 4.8 ppm	73
Figure 2-17 13C J-mod spectrum of mucilage 70C-2hr in D2O at 400MHz...	75
Figure 2-18 1H-1H COSY NMR spectrum of mucilage 70C-2hr in D2O at 600MHz.....	77
Figure 2-19 2D TOCSY NMR spectrum for mucilage 70°C-2hr in D2O at 600 MHz.....	78
Figure 2-20 2D HSQC NMR for mucilage 70C-2hr in D2O at 600 MHz	78
Figure 2-21 2D HMBC NMR spectrum for mucilage 70C-2hr in D2O at 600 MHz	79
Figure2-22 1H NMR spectrum for mucilage 50°C-15 min in D2O at 600 MHz.....	80
Figure 2-23 1H-1H COSY NMR spectrum for mucilage 50°C-15 min in D2O at 600 MHz.....	81

Figure 2-24 2D HMBC spectrum of mucilage 50C-15min in D2O at 600 MHz.....	82
Figure 2-25 2D HSQC NMR spectrum for mucilage 50°C-15 min in D2O at 600 MHz.....	83
Figure 2-26. The chemical structure of (A) Rhamnose pyranosyl sugar; (B) Glucuronic acid; (C) Glucuron- lactonring	85
Figure 2-27. (3R,5S)-3-(((2R,3S,6S)-2,3-dihydroxy-6-methyltetrahydro-2H-pyran-4-yl)oxy)-4,8-dihydroxy-2,6-dioxabicyclo[3.2.1]octan-7-one(Proposed repeating unites for the polymer).....	86
Figure 3-1 AFM topography images.....	105
Figure 3.2 Arithmetic average Roughness measurements of mucilage extracts compared with St Pectin and HPMC K100.....	108
Figure 3-3 The adhesion force (nN) of different mucilage extract, HPMC K100 and St. Pectin to mucin.....	109
Figure 4-1. Schematic diagram of Franz cells of diffusion components.....	118
Figure 4.2 Image of Franz cells system showing Franz cells and the stirring unite.....	124
Figure 4-3 Images of discs (A) Amitriptyline loaded mucilage(1:1), (B) Paracetamol loaded mucilage (1:1); (C) Amitriptyline loaded HPMC K100 (1:1), (D) Paracetamol loaded HPMC K100(1:1).....	127
Figure 4-4 Image of Paracetamol-mucilage disc into the 20mm culture plate.....	127
Figure 4.5 Images of inserts of (A) amitriptyline-mucilage (1:1), (B) Paracetamol-mucilage nasal inserts (1:1), (C) Amitriptyline-HPMCK100 (1:1), (D) paracetamol-HPMCK100 (1:1) nasal inserts.....	129
Figure 4-6 image of discs of (a) paracetamol-mucilage disc contains mannitol; image (b) paracetamol-HPMC K100 disc with mannitol.....	131
Figure 4.7 Images of disc prepared with glycerol (A) blank mucilage disc; (B) blank HPMC K100 disc with glycerol.....	131
Figure 4.8 Image of discs of (a) paracetamol-muiclage disc(1:2); (b) paracetamol-HPMC K100 discs (1:2).....	133
Figure 4.9 Images of (a) of culture plate contains paracetamol-mucilage (1:3) disc, image (b) of paracetamol-HPMC K100 disc (1:3).....	133

Figure 4.10 Paracetamol calibration curve (n=3).....	134
Figure 4.11 Amitriptyline HCl calibration curve (n=3).....	135
Figure 4.12 Percentage paracetamol released using a 5 mg paracetamol positive control (n=3)	136
Figure 4.13 Percentage released from Amitriptyline HCl positive control (n=3).....	136
Figure 4.14 The percentage release of paracetamol from the nasal inserts of different polymers.....	137
Figure 4.15 The percentage released of amitriptyline from mucilage and HPMC K100 nasal disc and nasal inserts.....	138
Figure 4.16 The Percentage released of amitriptyline from mannitol contained discs.....	139
Figure 4-17 The percentage released of paracetamol discs contained mannitol.....	140
Figure 5-1 The viscosity behaviour as a function of shear rate change.....	150
Figure 5-2 Carri-Med CSL-200 Rheometer apparatus.....	154
Figure 5.3 The flow rheology measurements. viscosity behaviour with shear.....	156
Figure 5.4 Oscillatory rheology measurements with amplitude stepped-Ramp stress for water maceration mucilage (n=3)	156
Figure 5.5 The Oscillatory rheology with frequency sweep for mucilage (HM 50C-2hr) and water maceration (WM) (n=3).....	157

List of Tables

Table 1 1 Taxonomic Hierarchy of <i>Capsella bursa-pastoris</i> L. Medikus.....	15
Table 1 2 Steps of Christ freezer dryer to lyophilisate mucilage.....	43
Table 2-2 Frequencies and intensities of functional groups on commercial pectin samples analysed by FTIR spectroscopy	50
Table 2-3 Standard calibration curve table for standard pectin DE along with absorption bands of interest with peak height and area under the curve of the sample peaks (n=10).....	51
Table 2-4 The peaks bands, peaks heights (H) and Area Under the Curve (AUC) of the same peaks of all samples from different mucilage extracts. The data shown were the mean \pm SD (n=10).....	55
Table 2-5. The cold crystallisation onset temperature and heat of crystallisation for all mucilage extracts (n=3).....	69
Table 2-6 The amounts of water absorbed by mucilage from different extracts (n=3).....	71
Table 2-7. Rhamnose $^{13}\text{C}/^1\text{H}$ chemical shifts.....	83
Table 2-8. Glucuronate $^{13}\text{C}/^1\text{H}$ chemical shifts.....	84
Table 3-1 Roughness and adhesion parameters for the blank mica-mucin in both the dried stage and hydrated step, along with the HPMC K100 LV, and St Pectin measurement.....	107
Table 4-1 Measurement of amitriptyline disc diameter and drug content with different polymers (n=10).....	128
Table 4.2 – Amitriptyline HCl and paracetamol content in different polymers' inserts and the inserts diameter (n=10).....	130
Table 4-3 Measurment of drug discs contained mannitol (n=6).....	132
Table 5-1 shows the viscosity reading of 10% w/w solution. These values are mean \pm SD (n=10).....	155

List of Abbreviations

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 (T_g)

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)