CONTENTS

LIST OF ABBREVIATIONS i - ii

LIST OF FIGURES iii - v

LIST OF TABLES vi – ix

1 INTRODUCTION AND REVIEW OF LITERATURE 1

1.1 Overview of acne pathogenesis 1
  1.1.1 Propionibacterium acnes 2
  1.1.2 Hormonal factors 2
  1.1.3 Sebum 3
  1.1.4 Nutrition 3
  1.1.5 Cytokines 4

1.2 Types of acne 4

1.3 Treatment of acne 4

1.4 Acne therapies and their limitations 5

1.5 Review of literature 5
  1.5.1 Medicinal plants with antimicrobial activity 6
  1.5.2 Medicinal plants with anti-inflammatory activity 15
  1.5.3 Medicinal plants with anti-oxidant activity 18
  1.5.4 Herbal formulations 21
  1.5.5 Others 23

1.6 Medicinal plants selected for the present study 27
  1.6.1 Azadirachta indica 27
  1.6.2 Calendula officinalis 29
  1.6.3 Camellia sinensis 31
  1.6.4 Glycyrrhiza glabra 33
  1.6.5 Linum usitatissimum 35
  1.6.6 Melaleuca alternifolia 37

1.7 Rationale of the study 39

1.8 Objective of the study 39
2 SCREENING FOR PHYTOCHEMICALS AND ANTIMICROBIAL POTENTIAL OF PLANTS 40

2.1 Introduction 40
   2.1.1 Justification of study 40
   2.1.2 Objectives of the study 41

2.2 Review of literature 42
   2.2.1 Phytochemical screening and physicochemical analysis 42
   2.2.2 Qualitative analysis 42
   2.2.3 Antimicrobial activity of medicinal plants 43

2.3 Experimental 46
   2.3.1 Chemicals 46
   2.3.2 Procurement and authentication of selected medicinal plants 47
   2.3.3 Physicochemical analysis of plants 48
   2.3.4 Preparation of extracts 49
   2.3.5 Preliminary phytochemical screening of extracts 51
   2.3.6 GCMS analysis of extracts 55
   2.3.7 Antimicrobial susceptibility testing 55

2.4 Results and discussion 60
   2.4.1 Screening for phytochemicals 60
   2.4.2 GCMS analysis 62
   2.4.3 In vitro antimicrobial susceptible testing 63

2.5 Conclusions 65

3 ANTI-OXIDANT ACTIVITY OF PLANT EXTRACTS 68

3.1 Introduction 68
   3.1.1 Justification of the study 69
   3.1.2 Objectives of the study 69

3.2 Review of literature 70
   3.2.1 Free radical damage 70
   3.2.2 Anti-oxidants 71
   3.2.3 Anti-oxidant assays 74

3.3 Experimental 76
   3.3.1 Chemicals 76
   3.3.2 Reconstitution of herbal extracts 77
   3.3.3 Phytochemical analysis 77
   3.3.4 Free radical scavenging assays 79
3.3.5 Statistical analysis 80

3.4 Results and discussion 80
3.4.1 Total phenolic, flavonoid and flavonol content 80
3.4.2 Ferric reducing anti-oxidant power 83
3.4.3 Free radical scavenging activity 83

3.5 Conclusions 86

4 VALIDATION OF HPTLC METHOD AND FINGERPRINTING OF ACTIVE PLANT EXTRACTS 87

4.1 Introduction 87
4.1.1 Justification of study 87
4.1.2 Objectives of the study 88

4.2 Review of literature 88
4.2.1 Validation of method 89
4.2.2 Fingerprinting of extracts 91

4.3 Experimental 92
4.3.1 Chemicals 92
4.3.2 Instrumentation 92
4.3.3 Validation of HPTLC method 93

4.4 Results and discussion 95
4.4.1 Linearity 95
4.4.2 Validation of the method 95
4.4.3 Fingerprinting of active plant extracts 97

4.5 Conclusions 97

5 DEVELOPMENT OF HERBAL GEL FORMULATIONS AND CHARACTERIZATION 99

5.1 Introduction 99
5.1.1 Justification of the study 100
5.1.2 Objectives of the study 100

5.2 Review of literature 100
5.2.1 Selection of excipients for development of formulation 100
5.2.2 In vitro antimicrobial screening 102

5.3 Experimental 103
5.3.1 Chemicals 103
5.3.2 Preparation of gel base 103
### 5.3.3 Preparation of topical gel formulations

### 5.3.4 Characterization of gel formulations

### 5.3.5 In vitro antimicrobial evaluation of gel formulation

### 5.3.6 Estimation of phytoconstituents in PI and PII gels

#### 5.4 Results and discussion

- **5.4.1 Characterization of herbal gels**
- **5.4.2 In vitro antimicrobial evaluation of gel formulation**
- **5.4.3 Estimation of phytoconstituent content in APEs and polyherbal gels**

#### 5.5 Conclusions

### 6 EX VIVO AND IN VIVO STUDIES OF POLYHERBAL GEL FORMULATIONS

#### 6.1 Introduction

- **6.1.1 Justification of the study**
- **6.1.2 Objectives of the study**

#### 6.2 Review of literature

- **6.2.1 Ex vivo permeation of topical formulations**
- **6.2.2 In vivo permeation**
- **6.2.3 Biodistribution studies**
- **6.2.4 In vivo anti-inflammatory approach**
- **6.2.5 Skin irritation studies**

#### 6.3 Experimental

- **6.3.1 Chemicals**
- **6.3.2 Ex vivo skin permeation studies**
- **6.3.3 In vivo skin permeation studies**
- **6.3.4 Biodistribution studies of 99mTc-labeled polyherbal gel formulations**
- **6.3.5 Anti-inflammatory activity**
- **6.3.6 Skin irritation study**
- **6.3.7 Accelerated stability studies**
- **6.3.8 Statistical analysis**

#### 6.4 Results and discussion

- **6.4.1 Ex vivo skin permeation of PI and PII gel formulation**
- **6.4.2 In vivo permeation studies**
- **6.4.3 Pharmacodynamic studies**
- **6.4.4 Biodistribution studies**
- **6.4.5 Skin irritation studies**
- **6.4.6 Accelerated stability studies**
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.5 Conclusions</td>
<td>138</td>
</tr>
<tr>
<td>6.6 General conclusion and recommendations</td>
<td>139</td>
</tr>
<tr>
<td>BIBLIOGRAPHY</td>
<td>141-179</td>
</tr>
<tr>
<td>APPENDIX</td>
<td>180-189</td>
</tr>
<tr>
<td>CURRICULUM VITTAE</td>
<td>190</td>
</tr>
</tbody>
</table>