# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>INNER FIRST PAGE</td>
<td>I</td>
</tr>
<tr>
<td>TABLE OF CONTENTS</td>
<td>IV-IX</td>
</tr>
<tr>
<td>DECLARATION BY THE SCHOLAR</td>
<td>X</td>
</tr>
<tr>
<td>SUPERVISOR’S CERTIFICATE</td>
<td>XI</td>
</tr>
<tr>
<td>ACKNOWLEDGEMENT</td>
<td>XII-XIII</td>
</tr>
<tr>
<td>ABSTRACT</td>
<td>XIV-XVI</td>
</tr>
<tr>
<td>LIST OF ABBREVIATIONS</td>
<td>XVII-XX</td>
</tr>
<tr>
<td>LIST OF SYMBOLS</td>
<td>XXI</td>
</tr>
<tr>
<td>LIST OF FIGURES</td>
<td>XXII-XXIII</td>
</tr>
<tr>
<td>LIST OF TABLES</td>
<td>XXIV-XXV</td>
</tr>
<tr>
<td>CHAPTER-1 : INTRODUCTION</td>
<td>1-19</td>
</tr>
<tr>
<td><strong>1.1. Introduction to peptic ulcer disease</strong></td>
<td></td>
</tr>
<tr>
<td>1.1.1 Layers and region of stomach</td>
<td>1-10</td>
</tr>
<tr>
<td>1.1.2 Cells of stomach lumen</td>
<td>2</td>
</tr>
<tr>
<td>1.1.3 Gastric acid secretion and regulation</td>
<td>2</td>
</tr>
<tr>
<td>1.1.4 Pathogenesis of peptic ulcer disease</td>
<td>3-6</td>
</tr>
<tr>
<td>1.1.5 Symptoms of peptic ulcer disease</td>
<td>5-10</td>
</tr>
<tr>
<td>1.1.6 Diagnosis of peptic ulcer disease</td>
<td>5</td>
</tr>
<tr>
<td>1.1.7 Treatment available</td>
<td>7</td>
</tr>
<tr>
<td><strong>1.2. Introduction to plant</strong></td>
<td></td>
</tr>
<tr>
<td>1.2.1 Synonyms</td>
<td>11-14</td>
</tr>
</tbody>
</table>

IV
1.2.2 Plant part used 11
1.2.3 Ayurvedic properties and action 11
1.2.4 Vernacular names 12
1.2.5 Macroscopical and Microscopical character 12-13
1.2.6 Chemical constituents 13-14
1.2.7 Pharmacological activities 13
1.2.8 Formulation and preparations 13
1.2.9 Safety aspects 13

1.3 Introduction to standardization and validation 15-19

1.3.1 Features that restricting development of herbal medicine in India 13
1.3.2 Standardization 15-16
1.3.3 Need of standardization 16
1.3.4 What is validation 16
1.3.5 Reasons for validation 16-17
1.3.6 Benefits of validation 17
1.3.7 Steps in method validation 17-18
1.3.8 Today’s validation requirements 18-19

CHAPTER-2 : REVIEW OF LETERATURE 20-32

2.1 Reviews on peptic ulcer disease 20–23

2.1.1 Helicobacter pylori & peptic ulcer disease 20-21
2.1.2 Nonsteroidal anti-inflammatory drugs (NSAIDs) & peptic ulcer disease 21
2.1.3 Stress & peptic ulcer disease 21
2.1.4 Smoking (nicotine) & peptic ulcer disease 21-22
2.1.5 Alcohol & peptic ulcer disease 22
2.1.6 Challenges to treatments 22

2.2 Reviews on natural approaches 23-26

2.3 Reviews on Paederia foetida 26-32
2.3.1 Phytochemistry 26-27
2.3.2 Therapeutic properties and mechanism of action 27-30
2.3.3 Traditional/foikoric uses in food and medicine 30-32

CHAPTER-3 : RATIONALE OF THE STUDY AND OBJECTIVES 33-35
3.1 Rationale of the study 33-34
3.2 Objectives 34-35

CHAPTER-4 : MATERIALS AND METHODS 36-59
4.1 Ethnobotanical survey 36-37
4.1.1 Description of study area: Tripura-North Eastern Region of India 36-37
4.1.2 Survey of the study area and group discussion 37

4.2 Selection and Collection of plant materials 38

4.3 Authentication of plant materials 38

4.4 Preparation of Extract 38

4.5 Preliminary phytochemical screening 38-40
4.5.1 Test for tannins 38
4.5.2 Test for flavonoids 39
4.5.3 Test for saponin glycoside 39
4.5.4 Test for anthraquinone glycoside 39
4.5.5 Test for cyanogenic glycoside 39
4.5.6 Test for cardiac glycoside 39
4.5.7 Test for iridoid glycoside 40
4.5.8 Test for alkaloid 40
4.5.9 Test for steroidal moiety 40
4.5.10 Test for reducing sugars 40
4.5.11 Test for amino acids 40
4.3.12 Qualitative HPTLC study of β-sitosterol 40

4.6 GC-MS Analysis of volatile constituents of *P. foetida* 40-42

4.6.1 Preparation of extract/oil 41
4.6.2 Preparation of sample for GC/MS analysis 41
4.6.3 GC/MS Instrumentation and chromatographic conditions 41-42
4.6.4 Identification of components 42

4.7 Standardization of *P. foetida* extract 42-48

4.7.1 Optimization of Thin layer chromatography solvent system 42-43
4.7.2 Development and validation of HPTLC method for simultaneous estimation of asperuloside and paederoside 43-45
4.7.3 Method validation 45-48

4.8 Evaluation of *in-vitro* antioxidant activity 48-49

4.8.1 Chemicals 48
4.8.2 Preparation of extract 48-49
4.8.3 DPPH® radical scavenging activity 49

VII
4.9 Assessment of in-vitro anti Helicobacter pylori activity

4.9.1 H. pylori strains and culture

4.9.2 Suspension Preparation

4.9.3 Determination of antimicrobial susceptibility and resistance

4.9.4 Minimum inhibitory concentration (MIC)

4.9.5 DNA extraction from H. pylori culture

4.9.6 Amplification of DNA by polymerase chain reaction by Multiplex PCR

4.9.7 Anti H. pylori assay

4.10 Evaluation of in-vivo anti-ulcer activity

4.10.1 Animals

4.10.2 Ethical approval

4.10.3 Indomethacin-pylorus ligation-induced ulcer

4.10.4 Alcohol induced gastric ulcer

4.10.5 Water immersion stress induced ulcer (WISIU)

4.10.6 Western blot analysis of in-vivo stomach tissue from pylorus ligatured rats

4.10.7 Statistical Analysis

CHAPTER-5 : RESULTS AND DISCUSSIONS

5.1 Ethnobotanical survey and selection of plant

5.2 Collection of plant material

5.3 Authentication of plant

5.4 Preparation of extract
5.5 Preliminary phytochemical screening 61-62
  5.5.1 Qualitative HPTLC study of β-sitosterol 62

5.6 GC-MS Analysis of volatile constituents of P. foetida 68-74
  5.6.1 GC/MS analysis of n-Hexane stem and leaf extract 68-74
  5.6.2 GC/MS analysis of hydro-distilled leaf oil 68-74

5.7 Standardization of P. foetida extract 75-80
  5.7.1 Optimization of Thin layer chromatography solvent system 75
  5.7.2 Development and validation of HPTLC method for simultaneous estimation of asperuloside and paederoside 76-80

5.8 Evaluation of in-vitro antioxidant activity 81-82

5.9 Assessment of in-vitro anti Helicobacter pylori activity 82-83

5.10 Evaluation of in-vivo anti-ulcer activity 88-89
  5.10.1 Indomethacin-pylorus ligation model 83-84
  5.10.2 Alcohol induced gastric ulcer model 85
  5.10.3 Water immersion stress induced ulcer (WISIU) model 85-86
  5.10.4 Western blot analysis of stomach tissue from pylorus ligatured rats 86-89

CHAPTER-6 : CONCLUSIONS 90-91
CHAPTER-7 : REFERENCES 92-113
LIST OF PUBLICATIONS 114
APPENDIX 115