## CONTENTS

List of Tables (i)-(ii)  
List of Plates (iii)-(v)  
List of Figures (vi)  
Abbreviations (vii)-(viii)  

### 1 INTRODUCTION  
1.1 Anxiety disorders: An overview  
1.2 Causes of anxiety disorders  
  1.2.1 Heredity/Genetic factors  
  1.2.2 Brain chemistry  
  1.2.3 Personality  
  1.2.4 Life experiences  
  1.2.5 Stress overload/Lifestyle factors  
  1.2.6 Thought patterns  
1.3 Management of anxiety disorders  
  1.3.1 Plants having anti-anxiety activity  
1.4 The genus *Turnera*  
  1.4.1 Ethnopharmacology  
    1.4.1.1 Traditional uses  
    1.4.1.2 Alternative and complementary medicinal uses  
  1.4.2 Morphology and microscopy  
  1.4.3 Phytoconstituents  
  1.4.4 Pharmacological studies  
  1.4.5 Clinical studies  
  1.4.6 Toxicology  
1.5 Standardization of plant drugs  
  1.5.1 Challenges in the standardization of plant drugs  
  1.5.2 Solutions for problems associated with plant drug standardization  
1.6 Experimental models for assessing anti-anxiety activity  
  1.6.1 Elevation
1.6.1.1 Elevated plus maze  47-48
1.6.1.2 Elevated zero maze  48
1.6.1.3 Elevated T maze  48-49
1.6.2 Novel environment  49-51
1.6.2.1 Open field behaviour  49
1.6.2.2 Hole board test  49
1.6.2.3 Social interaction in rats  50
1.6.2.4 Suppression of feeding by novelty  50
1.6.2.5 Staircase test  50-51
1.6.3 Bright illumination  51
1.6.3.1 Light/dark model  51
1.6.4 Mirror image  52
1.6.4.1 Mirrored chamber test  52
1.6.5 Physical discomfort  52-56
1.6.5.1 Four plate test in mice  52-53
1.6.5.2 Foot shock-induced freezing behaviour in rats  53
1.6.5.3 Distress vocalization in rat pups  53-54
1.6.5.4 Anticipatory anxiety in mice  54-55
1.6.5.5 Unconditioned conflict procedure  55-56
1.6.5.5.1 Vogel’s conflict test  55
1.6.5.5.2 Geller type conflict test  55-56
1.6.6 Social separation  56
1.6.6.1 Chick social separation-stress  56
1.6.7 Exposure to predator/predator’s odor  56-57
1.6.7.1 Cat odor exposure  56-57
1.6.7.2 Mouse defense test battery  57
1.6.8 Anxiogenic agents  57-58
1.6.8.1 Antagonism of discrimination stimuli produced by anxiogenic drugs  57-58
1.6.8.2 β-carboline-induced behavioural syndrome in monkeys  58
1.7 Research envisaged  60-61
## 2 EXPERIMENTAL

### 2.1 Materials and methods

1. **Plant materials**
2. **Solvents**
3. **Recovery of solvents**
4. **Microscopic techniques**
   - **Histochemical reagents**
   - **Macerating fluid**
   - **Clearing reagents and mountants**
5. **Moisture content**
6. **Ash value**
7. **Extractive value**
8. **Volatile oil studies**
   - **Volatile oil content**
   - **Refractive index**
   - **Specific gravity**
   - **Quantitative chemical tests**
9. **Biochemical estimations**
   - **Standards**
   - **Reagents and chemicals**
10. **Amino acid based fingerprint profiles**
11. **Chromatography**
   - **Solvents**
   - **Thin layer chromatography**
   - **Column chromatography**
   - **Preparative thin layer chromatography**
   - **High performance thin layer chromatography**
12. **Crystallization**
13. **Melting point determination**
14. **Spectroscopy**
   - **Ultra-violet spectroscopy**
   - **Nuclear magnetic resonance spectroscopy**
15. **Phytochemical screening**
2.1.16 Biological studies 68-72

2.1.16.1 Animals 68

2.1.16.2 Mother tinctures of *T. aphrodisiaca* 68

2.1.16.3 Vehicle 69

2.1.16.4 Standard drugs 69

2.1.16.5 Preparation of doses 69

2.1.16.6 Evaluation of anti-anxiety activity 69-71

2.1.16.6.1 Elevated plus maze model of anxiety 69

2.1.16.6.2 Hole board test 70

2.1.16.6.3 Light/dark test 70

2.1.16.6.4 Mirrored chamber test 70-71

2.1.16.7 Evaluation of aphrodisiac activity 71

2.1.16.8 Evaluation of sedative activity 71

2.1.16.9 Evaluation of anticonvulsant activity 71-72

2.1.16.10 Evaluation of antidepressant activity 72

2.1.16.11 Evaluation of antistress activity 72

2.1.16.12 Evaluation of analgesic activity 72

2.1.17 Statistics 73

2.2 Microscopic studies of *T. aphrodisiaca* and *T. ulmifolia* 73-100

2.2.1 Study of transverse sections 73-90

2.2.2 Study of powdered aerial parts 91

2.2.3 Determination of stomatal number and stomatal index 91

2.2.4 Determination of vein-islet number and veinlet termination number 91-98

2.2.5 Determination of palisade ratio 99

2.2.6 Determination of length and width of trichomes, vessels and pericyclic fibres 99-100

2.2.7 Determination of diameter of calcium oxalate crystals and starch grains 100

2.3 Moisture content of *T. aphrodisiaca* and *T. ulmifolia* 101

2.4 Ash value of *T. aphrodisiaca* and *T. ulmifolia* 101

2.5 Extractive value of *T. aphrodisiaca* and *T. ulmifolia* 101-102
2.6 Volatile oil studies of *T. aphrodisiaca* 102-107
  2.6.1 Volatile oil content 102
  2.6.2 Refractive index 102
  2.6.3 Specific gravity 103
  2.6.4 Quantitative chemical tests 103-107
    2.6.4.1 Acid value 103
    2.6.4.2 Saponification value 103-104
    2.6.4.3 Ester value 104
    2.6.4.4 Hydroxyl value 104
    2.6.4.5 Iodine value 104-105
    2.6.4.6 Peroxide value 105
    2.6.4.7 Unsaponifiable matter 105-106
    2.6.4.8 Acetyl value 106

2.7 TLC fingerprint profiles of *T. aphrodisiaca* and *T. ulmifolia* 107-113

2.8 Biochemical estimations of *T. aphrodisiaca* and *T. ulmifolia* 114-118
  2.8.1 Estimation of proteins 114-116
    2.8.1.1 Preparation of extraction buffer 114
    2.8.1.2 Preparation of standard solutions 114
    2.8.1.3 Preparation of test samples 114
    2.8.1.4 Preparation of Biuret reagent 114
    2.8.1.5 Preparation of standard curve 115
    2.8.1.6 Determination of protein content in test samples 115-116
  2.8.2 Estimation of carbohydrates 116-118
    2.8.2.1 Preparation of standard solutions 116
    2.8.2.2 Preparation of test samples 116-117
    2.8.2.3 Preparation of anthrone reagent 117
    2.8.2.4 Preparation of standard curve 117
    2.8.2.5 Determination of carbohydrate content in test samples 117-118

2.9 Amino acid based fingerprint profiles of *T. aphrodisiaca* and *T. ulmifolia* 118-119

2.10 Phytochemical screening of *T. aphrodisiaca* and *T. ulmifolia* 119-121
2.11 Anti-anxiety activity screening of _T. aphrodisiaca_ and _T. ulmifolia_ aerial parts

2.12 Anti-anxiety activity screening of marketed formulations of _T. aphrodisiaca_

2.13 Aphrodisiac activity screening of _T. aphrodisiaca_

2.14 Anti-anxiety activity-guided fractionation of _T. aphrodisiaca_

   2.14.1 Preparation of methanol extract

   2.14.2 Column chromatography of methanol extract

   2.14.3 Characterization of AS_i

2.15 Quantitative determination of AS_i in _T. aphrodisiaca_ aerial parts, and its marketed formulations

   2.15.1 Preparation of standard solution

   2.15.2 Preparation of test samples

      2.15.2.1 Direct method

      2.15.2.2 Acid hydrolysis

   2.15.3 Preparation of standard curve

   2.15.4 Estimation of AS_i content in test samples

   2.15.5 Validation of HPTLC assay

2.16 Pharmacological profile of AS_i

   2.16.1 Anti-anxiety activity

      2.16.1.1 Hole board test

      2.16.1.2 Light/dark test

      2.16.1.3 Mirrored chamber test

   2.16.2 Sedative activity

   2.16.3 Anticonvulsant activity

   2.16.4 Antidepressant activity

   2.16.5 Antistress activity

   2.16.6 Analgesic activity

3 DISCUSSION

   3.1 Authentication of _T. aphrodisiaca_

   3.2 Anxiolytic activity screening of _T. aphrodisiaca_ and _T. ulmifolia_

   3.3 Anti-anxiety activity screening of marketed formulations of _T. aphrodisiaca_
<table>
<thead>
<tr>
<th>Section</th>
<th>Page Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.4 Aphrodisiac activity screening of <em>T. aphrodisiaca</em></td>
<td>155-156</td>
</tr>
<tr>
<td>3.5 Isolation of bioactive constituent(s) of <em>T. aphrodisiaca</em></td>
<td>156</td>
</tr>
<tr>
<td>3.6 The bioactive constituent of <em>T. aphrodisiaca</em></td>
<td>156</td>
</tr>
<tr>
<td>3.6.1 Characterization of AS$_{1}$</td>
<td>157</td>
</tr>
<tr>
<td>3.6.2 Anxiolytic activity of apigenin – a comment</td>
<td>157</td>
</tr>
<tr>
<td>3.7 HPTLC of aerial parts of <em>T. aphrodisiaca</em>, and its marketed formulations</td>
<td>158-159</td>
</tr>
<tr>
<td>3.8 Pharmacological profile of apigenin</td>
<td>159-160</td>
</tr>
<tr>
<td>3.9 Conclusion</td>
<td>160-161</td>
</tr>
<tr>
<td>3.10 Monograph on Damiana</td>
<td>161-165</td>
</tr>
</tbody>
</table>

**4 REFERENCES**                                                          | 165-186     |