List of figures  ix-xvii
List of photoplates xviii-xix
List of tables xx-xxi

Chapter-1:  
General Introduction  1-7

Chapter-2:  
Review of Literature  8-34

2.1. Biological diversity  8
2.2. Biodiversity of freshwater cyanobacteria  11
2.3. Morphological diversity  13
2.4. Physical factors  15
  2.4.1. Temperature  15
  2.4.2. Turbulence and mixing  15
  2.4.3. Light  16
2.5. Light harvesting pigments  16
2.6. Phycobiliproteins  17
2.7. Structural units of the phycobiliproteins  18
  2.7.1. Phycoerythrins  18
  2.7.2. Phycocyanin  18
  2.7.3. Allophycocyanin  19
2.8. Applications of cyanobacteria in biotechnology  19
  2.8.1. As colourant  20
  2.8.2. As pharmaceutical agent  20
  2.8.3. Food and feed  21
  2.8.4. Fine chemicals  21
  2.8.5. Biofertilizer  22
Chapter-3:
Physio-geographical characteristics of Loktak lake 35-37
3.1. The Lake ecosystem 36

Chapter-4:
Isolation, identification and maintenance of cyanobacteria from Loktak lake, Manipur 38-73
4.1. Introduction 38
4.2. Materials and methods 40
   4.2.1. Description of study site 40
   4.2.2. Collection of samples 40
   4.2.3. Physico-chemical parameters of water samples 42
   4.2.4. Preparation of the medium 42
   4.2.5. Isolation of cyanobacteria 42
   4.2.6. Identification of cyanobacterial strains 43
   4.2.7. Maintenance of cyanobacterial strains 44
   4.2.8. Diversity indices 44
   4.2.9. Relative abundance 44
4.3. **Results**

4.3.1. Cyanobacterial strains isolated from Loktak lake

4.3.2. Seasonal variation of cyanobacterial strains

4.3.3. Physico-chemical parameters of water samples

4.3.4. Diversity indices

4.4. **Discussion**

**Chapter-5:**

**Biochemical characterization of the isolated cyanobacteria for phycobiliproteins and ammonia excretion**

5.1. **Introduction**

5.2. **Materials and methods**

5.2.1. Screening of cyanobacterial strains

5.2.1.1. **Inoculum preparation**

5.2.1.2. **Estimation of chlorophyll-a**

5.2.1.3. **Estimation of phycobiliproteins**

5.2.1.4. **Estimation of extracellular ammonia excretion**

5.2.2. **Nitrogenase activity of heterocystous cyanobacterial strains**

5.2.3. Lipid composition and fatty acid profiling of non-heterocystous strains

5.2.3.1. **Lipid extraction and transesterification**

5.2.3.2. **GC analysis**

5.2.4. Selection of cyanobacterial strains

5.2.5. Effect of light qualities on phycobiliproteins and extracellular ammonia excretion

5.2.6. Effect of different levels of nitrate and phosphate on phycobiliproteins and extracellular ammonia excretion
5.2.7. Effect of pH on phycobiliproteins and extracellular ammonia excretion 80
5.2.8. Statistical analysis 81

5.3. Results 81
5.3.1. Biochemical characterization of chl-a, phycobiliproteins and extracellular ammonia excretion 81
5.3.2. Nitrogenase activity 88
5.3.3. Lipid composition 91
5.3.4. Effect of light qualities on phycobiliproteins content 95
5.3.5. Effect of light qualities on extracellular ammonia excretion 99
5.3.6. Effect of nutrients (nitrate and phosphate) on phycobiliproteins 100
5.3.7. Effect of nutrients (nitrate and phosphate) on extracellular ammonia excretion 103
5.3.8. Effect of different levels of pH on phycobiliproteins production 106
5.3.9. Effect of pH on extracellular ammonia excretion 108
5.3.10. Statistical analysis 109

5.4. Discussion 109

Chapter-6:

PCR based molecular characterization of cyanobacteria 116-144

6.1. Introduction 116
6.2. Materials and methods 118
6.2.1. DNA extraction 118
6.2.2. DNA quantification and quality analysis 120
6.2.3. Agarose gel electrophoresis 120
6.2.4. Randomly amplified polymorphic DNA (RAPD-PCR) 121

6.2.4.1. Phylogenetic analysis of RAPD 122

6.2.5. 16S rRNA gene 122

6.2.5.1. Amplification of the 16S rRNA gene 122

6.2.5.2. Sequencing of the 16S rRNA gene 123

6.2.5.3. Phylogenetic analysis 16S rRNA sequence 123

6.2.6. Restriction fragment length polymorphism (RFLP) 124

6.2.6.1. Phylogenetic analysis of RFLP 124

6.3. Results

6.3.1. DNA extraction 124

6.3.2. Randomly amplified polymorphic DNA 125

6.3.3. Analyses of 16S rRNA sequence (BLASTN analysis) 128

6.3.4. Genetic distance analysis with RAPD, RFLP and 16S rRNA markers 130

6.3.5. Construction of phylogenetic tree 136

6.4. Discussion 140

Chapter-7:

Development of database of potent strains 145-157

7.1. Introduction 145

7.2. Materials and methods 145

7.3. Results 146

7.4. Discussion 157

Chapter-8:

General discussion 158-167

Summary 168-176

References 177-211

Appendix xxii-xxix