

Contents

| | |
|--|-----|
| ACKNOWLEDGEMENTS..... | III |
| THESIS ABSTRACT..... | VI |
| LIST OF FIGURES | X |
| LIST OF TABLES..... | XIV |
| | |
| CHAPTER 1: APPROXIMATING CHEMISTRY | |
| INTRODUCTION..... | 1 |
| MOLECULAR MODELING..... | 2 |
| QUANTUM MECHANICS..... | 5 |
| MOLECULAR MECHANICS | 10 |
| <i>Forcefields</i> | 10 |
| <i>Pseudoatoms</i> | 16 |
| <i>Minimization Techniques</i> | 17 |
| <i>Molecular Dynamics</i> | 19 |
| <i>Monte Carlo</i> | 21 |
| REFERENCES | 24 |
| | |
| CHAPTER 2: DEVELOPMENT OF A BIOLOGICAL UNIVERSAL FORCEFIELD | |
| ABSTRACT..... | 25 |
| INTRODUCTION..... | 26 |
| METHODS..... | 28 |
| PARAMETERIZATION | 29 |
| <i>The Charge Scheme</i> | 30 |
| <i>Hydrogen bond potentials</i> | 36 |
| <i>Torsional space</i> | 46 |
| VALIDATION AND COMPARISON STUDIES..... | 52 |
| <i>Gly-XXX-Gly Tripeptides</i> | 52 |
| <i>Polyalanine α-Helices</i> | 59 |
| <i>X-ray crystal structure minimization</i> | 67 |
| <i>Alanine tetrapeptide helix/sheet folding</i> | 70 |
| CONCLUSION..... | 75 |
| REFERENCES | 76 |

**CHAPTER 3: AN EXAMINATION OF SOLVENT EFFECTS ON
PEPTIDE TORSIONS**

| | |
|---|------------|
| ABSTRACT..... | 78 |
| INTRODUCTION..... | 79 |
| METHODS..... | 80 |
| RESULTS..... | 87 |
| DISCUSSION..... | 93 |
| CONCLUSION..... | 95 |
| REFERENCES | 96 |
| | |
| APPENDIX A – BUFF PARAMETERS..... | 98 |
| | |
| APPENDIX B – BUFF CONVERSION FILE..... | 105 |