CONTENTS

CHAPTER-I INTRODUCTION 1

CHAPTER-II REVIEW OF LITERATURE 4
2.1 World Production of Oils and Fats 4
2.2 Oleaginous micro-organism 9
2.3 Factors affecting lipid accumulation 25
2.4 Lipid biosynthesis in oleaginous yeast 31
2.5 Stoichiometry of lipid accumulation 33
2.6 Fermentation processes for single cell oil production 34

CHAPTER-III MATERIALS AND METHODS 39
3.1 Microorganism 39
3.2 Growth/Fermentation medium 39
3.3 Fermentation studies 39
3.3.1 Fermentation studies with molasses 42
3.3.2 Lipid rich cells as source of inoculum 43
3.4 Biotransformation of vegetable oils 43
3.5 Transformation of self produced lipids 43
3.6 Analytical methods 44

CHAPTER-IV RESULTS AND DISCUSSION 47
4.1 OPTIMISATION OF GROWTH 47
4.1.1 Effect of Temperature 47
4.1.2 Effect of pH 52
4.1.3 Effect of Carbon Source 52
4.1.4 Effect of Nitrogen Source 55
<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.2</td>
<td>OPTIMIZATION OF LIPID ACCUMULATION</td>
<td>56</td>
</tr>
<tr>
<td>4.2.1</td>
<td>Effect of Cultivation Technique</td>
<td>56</td>
</tr>
<tr>
<td>4.2.2</td>
<td>Effect of Fermentation Temperature</td>
<td>61</td>
</tr>
<tr>
<td>4.2.3</td>
<td>Effect of Fermentation pH</td>
<td>65</td>
</tr>
<tr>
<td>4.2.4</td>
<td>Effect of Carbon Source</td>
<td>68</td>
</tr>
<tr>
<td>4.2.5</td>
<td>Utilization of Molasses for Lipid Production</td>
<td>75</td>
</tr>
<tr>
<td>4.2.6</td>
<td>Effect of Nitrogen Source</td>
<td>83</td>
</tr>
<tr>
<td>4.2.7</td>
<td>Effect of nitrogen and phosphate limitation</td>
<td>85</td>
</tr>
<tr>
<td>4.2.8</td>
<td>Effect of Lipid Rich CD Cells as an Inoculum</td>
<td>87</td>
</tr>
<tr>
<td>4.3</td>
<td>INFLUENCE OF GROWTH CONDITIONS ON STEROL ACCUMULATION</td>
<td>92</td>
</tr>
<tr>
<td>4.4</td>
<td>BIOTRANSFORMATION</td>
<td>99</td>
</tr>
<tr>
<td>4.4.1</td>
<td>Biotransformation of Vegetable Oils</td>
<td>99</td>
</tr>
<tr>
<td>4.4.2</td>
<td>Biotransformation of Self Produced Lipids</td>
<td>101</td>
</tr>
<tr>
<td>4.5</td>
<td>BIOEMULSIFIER AS A BY-PRODUCT OF SINGLE CELL OIL</td>
<td>105</td>
</tr>
</tbody>
</table>

CHAPTER-V SUMMARY AND CONCLUSION 115

REFERENCES 118
LIST OF FIGURES

FIG. 2.1 Pathway of Lipid Biosynthesis in Oleaginous Yeasts 32

FIG. 2.2 Microbial Oil Process Flow Diagram 36

FIG. 4.1 Effect of Temperature on the Growth of Rhodotorula glutinis IIP-30 50

FIG. 4.2 Arhenius Plot for the Calculation of Activation Energy 51

FIG. 4.3 Effect of pH on the Growth of R. glutinis IIP-30 53

FIG. 4.4 Pattern of Lipid Accumulation in R. glutinis IIP-30 59

FIG. 4.5 Comparison of Batch and Fed Batch Fermentation Techniques for Lipid Production by R. glutinis IIP-30 60

FIG. 4.6 Effect of Temperature on Lipid Production by R. glutinis IIP-30 64

FIG. 4.7 Effect of Carbon Source on Lipid Production by R. glutinis IIP-30 69

FIG. 4.8 Relationship of Fermentation Time to Glucose Utilization and Biomass Production in fed batch fermentation. 70

FIG. 4.9 Relationship of Fermentation Time to Sucrose Utilization and Biomass Production in fed batch fermentation. 71
FIG. 4.10 Utilization of molasses for lipid production by R. glutinis IIP-30

FIG. 4.11 Effect of Nitrogen and Phosphate Limitation on Lipid Production by R. glutinis IIP-30

FIG. 4.12 Biomass concentration and Emulsification Activity of the Broth Obtained Using Glucose and Sucrose as substrates.


FIG. 4.14 Emulsification Activity for Different Hydrocarbons Shown by R. glutinis IIP-30 during Fed Batch Fermentation at different temperatures.

FIG. 4.15 Emulsification Activity in Cell Free Broth of R. glutinis IIP-30 Grown at Different pH.