

## TABLE OF CONTENT

<b>COVER</b>	<b>i</b>
<b>RATIFICATION PAGE</b>	<b>ii</b>
<b>STATEMENT</b>	<b>iii</b>
<b>DEDICATION PAGE</b>	<b>iv</b>
<b>PREFACE</b>	<b>v</b>
<b>TABLE OF CONTENT</b>	<b>vi</b>
<b>LIST OF FIGURE</b>	<b>ix</b>
<b>LIST OF TABLE</b>	<b>x</b>
<b>LIST OF APPENDICES</b>	<b>xi</b>
<b>ABSTRACT</b>	<b>xii</b>
<b>INTISARI</b>	<b>xiii</b>
<b>CHAPTER I INTRODUCTION</b>	<b>1</b>
I.1 Background	1
II.2 Research Objectives	3
II.3 Research Benefits	4
<b>CHAPTER II LITERATURE REVIEW AND HYPOTHESIS</b>	<b>5</b>
II.1 Literature Review	5
II.1.1 Biodiesel	5
II.1.2 <i>Moringa Oleifera</i> (kelor) leaves as a catalyst	6
II.1.3 Malapari Oil ( <i>Pongamia pinnata</i> (L.) Pierre)	8
II.1.4 Transesterification in Biodiesel Production	13
II.2 Hypothesis Design and Research Design	13
II.2.1 Hypothesis Design I	13
II.2.2 Hypothesis Design II	14
II.2.3 Research design	15

<b>CHAPTER III RESEARCH METHOD</b>	<b>16</b>
III.1 Materials	13
III.2 Equipments	13
III.3. Research Procedure	13
III.3.1 <i>Moringa Oleifera</i> leaves ash catalyst preparation	13
III.3.2 Degumming of Malapari oil	13
III.3.3 Esterification of Malapari oil	17
III.3.4 Free fatty acids analysis	17
III.3.5 Malapari oil transesterification in biodiesel	18
<b>CHAPTER IV RESULT AND DISCUSSION</b>	<b>22</b>
IV.1 Characteristics of catalyst	22
IV.1.2 Element analysis by XRF	23
IV.1.3 Crystallinity analysis by XRD	24
IV.1.4 Functional analysis by FTIR	26
IV.1.5 Catalyst surface analysis by SEM-EDX	28
IV.2 Free Fatty Acids (FFA) analysis	30
IV.3 Application of Malapari oil in biodiesel production	31
IV.3.1 Degumming of Malapari oil	31
IV.3.2 Esterification of Malapari oil	32
IV.3.3 Transesterification of Malapari Oil	34
IV.3.3.1 Effect of catalyst weight on biodiesel yield	36
IV.3.3.2 Effect of reaction temperature on biodiesel yield	37
IV.3.3.3 Effect of oil:methanol mole ratio on biodiesel yield	39
IV.3.3.4 Effect of reaction time on biodiesel yield	41
IV.4 Characterization of Malapari oil and biodiesel	43
IV.4.1 Functional group analysis of low-grade Malapari oil and optimum biodiesel yield by FTIR	44

IV.4.2 Analysis of low-grade Malapari oil and biodiesel GCMS	44
IV.5 Usability test of MA-900 catalyst	46
<b>CHAPTER V CONCLUSION AND SUGGESTION</b>	<b>50</b>
V.1 Conclusion	50
V.2 Suggestion	50
<b>REFERENCE</b>	<b>51</b>
<b>APPENDICES</b>	<b>54</b>