

**SYNTHESIS, CHARACTERIZATION AND
CATALYTIC ACTIVITY OF CaO-BASED
CATALYSTS IN TRANSESTERIFICATION OF
NON-EDIBLE AND WASTE COOKING OILS
INTO GLYCEROL-FREE FATTY ACID METHYL
ESTER**

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UNIVERSITI SAINS MALAYSIA

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ACID METHYL ESTER**

by

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LIST OF ABBREVIATIONS

ASTM	American Society for Testing Material
B7	7% Biodiesel
B10	10% Biodiesel
B20	20% Biodiesel
B100	100% Biodiesel
BET	Brunnauer-Emmet-Teller
CJO	Crude Jatropha Oil
CKO	Crude Karanj Oil
CPKO	Crude Palm Kernel Oil
CPO	Crude Palm Oil
DDGC	Distillers Dried Grain Solubles
DMC	Dimethyl Carbonate
EDX	Energy Dispersive X-ray
FAGC	Fatty Acid Glycerol Carbonate
FAME	Fatty Acid Methyl Ester
FFA	Free Fatty Acid
FTIR	Fourier Transform Infra Red
GC	Glycerol Carbonate
GDC	Glycerol Dicarboxylate
GHG	Greenhouse Gases
IEA	International Energy Agency
JCPDS	Joint Committee of the Powder Diffraction Standard
MPOB	Malaysia Palm Oil Board
RED	Renewable Energy Directive

SAP	Super Absorbent Polymer
SEM	Scanning Electron Microscopy
TG	Triglyceride
TGA	Thermogravimetric Analyzer
TPD	Temperature Programmed Desorption
US EIA	United States-Energy Information Administration
WCO	Waste Cooking Oil

LIST OF SYMBOLS

θ	Theta
ρ	Rho
γ	Gamma

**SINTESIS, PENCIRIAN DAN PRESTASI MANGKIN OLEH MANGKIN
BERASAS CaO DALAM TRANSESTERIFIKASI MINYAK SAYUR TIDAK
BOLEH DIMAKAN DAN SISA MINYAK SAYUR UNTUK
MENGHASILKAN METIL ESTER ASAM BERLEMAK BEBAS GLISEROL**

ABSTRAK

Biodiesel juga dikenali sebagai asid lemak metil ester (ALME), telah menjadi lebih menarik sebagai bahan api alternatif disebabkan oleh kebolehan perbaharui dan pengeluaran bahan cemar yang rendah. Sintesis biodiesel telah dijalankan melalui transesterifikasi menggunakan dimetil karbonat (DC) untuk menggantikan metanol menggunakan pemangkin heterogen untuk mengatasi produk sampingan gliserol yang berlebihan dan untuk mengelakkan penggunaan air sisa yang besar untuk proses penulenan. Penyelidikan ini bertujuan untuk membangunkan mangkin heterogen yang aktif, stabil dan boleh digunakan semula untuk transesterifikasi minyak sayur tidak boleh dimakan dan sisa minyak masak (SMM) dengan DC untuk menghasilkan ALME bebas gliserol. Mangkin-mangkin campuran oksida berasaskan CaO (Ca-Zn, Ca-La dan Ca-La-Al) telah dibangunkan melalui kaedah permendakan diikuti oleh pengkalsinan antara suhu 300 °C hingga 900 °C dan masa 1 jam hingga 5 jam. Analisis termal gravimetri, isoterma penyerapan-nyah penyerapan N₂, penyerakan X-ray, Infra merah pengubahan Fourier, mikroskopi elektron imbasan-X-ray taburan tenaga dan analisis penyahjerapan program suhu telah dijalankan untuk mencirikan mangkin. Prestasi mangkin telah dinilai berdasarkan tindak balas transesterifikasi menggunakan proses kelompok pada keadaan operasi yang berbeza, termasuk suhu (110-190 °C), masa tindak balas (30-360 min), nisbah DC kepada minyak (2:1-18:1) dan jumlah mangkin (1-13 % berat, bergantung kepada berat minyak). Keputusan menunjukkan bahawa mangkin campuran oksida