BIODIESEL PRODUCTION FROM NON-EDIBLE OIL VIA TRANSESTERIFICATION REACTION USING HETEROGENEOUS CATALYST DERIVED FROM POST-HARVEST PLANTS

A THESIS

SUBMITTED TO BODOLAND UNIVERSITY FOR THE DEGREE OF DOCTOR OF PHILOSOPHY IN CHEMISTRY IN THE FACULTY OF SCIENCE AND TECHNOLOGY

SUBMITTED BY

BIDANGSHRI BASUMATARY

DEPARTMENT OF CHEMISTRY

BODOLAND UNIVERSITY, KOKRAJHAR–783370, INDIA

APRIL, 2024

Dedication

Dedicated to my dearest father, mother, aunt, husband, mentors and teachers

BODOLAND UNIVERSITY
DEPARTMENT OF CHEMISTRY
Debargaon, P.O. Rangalikhata
Kokrajhar - 783 370, BTR, Assam, India

Dr. Sanjay Basumatary, M.Sc., Ph.D.
Professor & Head

Tel: +91 (9954336448; 7002166299)
Email: waytosanjay12@gmail.com

April 10, 2024

Certificate

This is to certify that the work described in the thesis entitled ***Biodiesel production from non-edible oil via transesterification reaction using heterogeneous catalyst derived from post-harvest plants*** was carried out by Ms. Bidangshri Basumatary in the Department of Chemistry, Bodoland University, Kokrajhar, under my guidance and supervision. Ms. Bidangshri Basumatary has fulfilled all the requirements under Ph.D. rules and regulations of Bodoland University for submitting her thesis for the award of Ph.D. degree. The thesis is the result of her own-investigation, and no part of the thesis is submitted for any other degree or diploma to this or any other university.

10-04-2024

(S. Basumatary)

Declaration by the candidate

I, **Bidangshri Basumatary,** do hereby declare that the research work described in the thesis entitled ***Biodiesel production from non-edible oil via transesterification reaction using heterogeneous catalyst derived from post-harvest plants*** in partial fulfilment of the requirement for the degree of Doctor of Philosophy in Chemistry and submitted to Bodoland University, Kokrajhar, Assam, India, is a result of original research work carried out by me under the supervision of Dr. Sanjay Basumatary, Professor & Head, Department of Chemistry, Bodoland University, Kokrajhar. No portion of the thesis has been submitted to this or any other university for any other degree, diploma or certificate.

Place: Kokrajhar
Date: 10/04/2024

Bidangshri Basumatary

Bidangshri Basumatary
Department of Chemistry
Bodoland University,
Kokrajhar- 783370

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Bidangshri Basumatary

Bidangshri Basumatary

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Abbreviations

WCO	Waste cooking oil
MTOMR	Methanol to oil molar ratio
MBCUS	*Musa balbisiana* Colla underground stem
ORCs	Optimum reaction conditions
JCO	*Jatropha curcas* oil
HT	High pressure–high temperature
Viz.	Namely
S	Second
nm	Nanometre
M	Molarity
N	Normality
Mmol	Millimole
mol/L	Moles per litre
Mm	Millimetre
mL	Millilitre
min	Minute
mg	Milligram
mmol g^{-1}	Milimole per gram
$m^2 g^{-1}$	Square mitre per gram
$cm^3 g^{-1}$	Cubic centimetre per gram
L	Litre
mg/L	Milligram per litre
Kg	Kilogram
Kcal	Kilocalorie
JCPDS	Joint committee on powder diffraction standards
H_	Hammett strength
g	Gram
h	Hour
FAME	Fatty acid methyl ester
EN	European norms
ASTM	American society for testing and materials

SN	Saponification number
HHV	Higher heating value
wt. %	Weight percentage
TOF	Turnover frequency
AV	Acid value
BET	Brunauer-Emmett-Teller
BJH	Barrett-Joyner-Halenda
EDX	Energy dispersive X-ray
FESEM	Field emission scanning electron microscope
FFA	Free fatty acid
FT-IR	Fourier transform infrared spectrometer
GC-MS	Gas chromatography-mass spectrometry
HRTEM	High resolution transmission electron microscope
IV	Iodine value
MRMO	Molar ratio of methanol to oil
NMR	Nuclear magnetic resonance
ORCs	Optimum reaction conditions
SAED	Selected area electron diffraction
SN	Saponification number
TGA	Thermogravimetric analysis
TLC	Thin layer chromatography
TOF	Turnover frequency
XPS	X-ray photoelectron spectrometer
XRD	X-ray diffractometer
CFPP	Cold filter plugging point
BMCP	Burnt *Musa champa* peel catalyst
BMCR	Burnt *Musa champa* rhizome catalyst
BMCS	Burnt *Musa champa* stem catalyst
CMCP-550	Calcined *Musa champa* peel catalyst at 550 ^{o}C
CMCR-550	Calcined *Musa champa* rhizome catalyst at 550 ^{o}C
CMCS-550	Calcined *Musa champa* stem catalyst at 550 ^{o}C
SBCC	Sugarcane bagasse calcined catalyst
BBP	Burnt Bharatmoni peel
BBS	Burnt Bharatmoni stem

BBR	Burnt Bharatmoni rhizome
CBP-550	Calcined Bharatmoni peel at 550 ^{o}C
CBS-550	Calcined Bharatmoni stem at 550 ^{o}C
CBR-550	Calcined Bharatmoni rhizome at 550 ^{o}C
XRD	X-ray diffractometer
EDX	Energy dispersive X-ray
FESEM	Field emission scanning electron microscope
FT-IR	Fourier transform infrared spectrometer
GC-MS	Gas chromatography-mass spectrometry
HRTEM	High resolution transmission electron microscope
NMR	Nuclear magnetic resonance
SAED	Selected area electron diffraction