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**Extraction, and Physicochemical Characterization of the Oil
Biodiesel and blends from seeds of *Ricinus Communis*
(Castor Beans)**

إستخلاص وتوصيف الخصائص الفيزيائية والكيميائية لزيت الوقود الحيوي
ومخاليطه من حبوب الخروع

**A Thesis submitted in fulfillment for the requirements of the degree
of Doctor of Philosophy in Chemistry**

By

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الإستهلال

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

(فَبَدَأَ بِأَوْعِيَّتِهِمْ قَبْلَ وِعَاءِ أَخِيهِ ثُمَّ
اسْتَخْرَجَهَا مِنْ وِعَاءِ أَخِيهِ كَذَلِكَ كِدْنَا
لِيُوسُفَ مَا كَانَ لِيَأْخُذَ أَخَاهُ فِي دِينِ الْمَلِكِ
إِلَّا أَنْ يَشَاءَ اللَّهُ نَرْفَعُ دَرَجَاتٍ مَن نَّشَاءُ
وَفَوْقَ كُلِّ ذِي عِلْمٍ عَلِيمٌ).

صدق الله العظيم

(يوسف: 76)

Dedication

To my parents, husband, daughters and brother.

To the soul of Asma Satti.

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Praise to Allah Almighty who gave me health and patience to complete this work.

I would like to express my sincere gratitude to my supervisor Prof. Mohammed EL Mubark Osman for the continuous support, patience, motivation, and immense knowledge. His guidance helped me in stages of this of research.

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Abstract

This study aims to obtain a sustainable source of energy from natural and environmentally friendly resources.

Ricinus communis seeds collected from Dongola city, northern state – Sudan were used as raw material for preparing biofuels and blends.

The oil was extracted from *Ricinus Communis* seeds using different techniques: chemical solvent extraction by soxhlet, cold chemical extraction with solvent and mechanical pressing. Percent oil yields were 49.0%, 35.5% and 31.2%, respectively. Gc/mass analysis showed the oil contained 82.14% Saturated fatty acids, 17.85% unsaturated fatty acids. The degree of saponification was 165.5 mgKOH /g, and it was found that the density value and the gravity factor are equal.

Biofuels were prepared by two methods, acid catalyzed esterification reaction and alkali-stimulated esterification using sodium hydroxide. Gas chromatography technique/mass spectrometer demonstrated that *Ricinus Communis* oil is converted biofuel.

The physical and chemical properties of the Biodiesel were verified according to the American Standard Test No. D 6751 and it was found that biofuel had met all of the standard requirements of the standard.

The mixture of *Ricin's Communis* fuel with fossil diesel No. D20 has been tested according to American Specifications No. D 7467 and has successfully passed the requirements of the standard. Also, two types of biofuel blends were prepared Biodiesel (20/80), fossil diesel and Biodiesel fossil diesel and ethanol (20/60/20) were prepared and compared with the ASTM No. D 7467. The three types of mixture met the standard requirements except for viscosity testing, where the viscosity level of biofuel fuel was 17.37 C⁰ higher than the ASTM.

The acid number ratio was slightly higher than the standard and it was 0.6 mgKoH/g.

المستخلص

تهدف هذه الدراسة إلى الحصول على مصدر مستدام للطاقة من الموارد الطبيعية والصدقية للبيئة.

تم جمع بذور نبات الخروع من مدينة دنقلا - الولاية الشمالية - السودان كمادة خام لتحضير الوقود الحيوي ومزيجه.

تم استخلاص الزيت من بذور الخروع باستخدام تقنيات مختلفة وهي استخلاص المذيبات الكيميائية عن طريق السوكسلت و استخلاص المواد الكيميائية مع المذيبات و الضغط الميكانيكي. و بلغت نسبة المستخلصات 49.0% و 35.5% و 31.2% على التوالي. أظهر تحليل Gc/mass أن الزيت يحتوي على 82.14% من الأحماض الدهنية المشبعة و 17.85% من الأحماض الدهنية غير المشبعة. كانت درجة التصبن 165.5mg/KOH ، وتبين أن قيمة الكثافة وعامل الجاذبية متساويان.

تم تحضير الوقود الحيوي بطريقتين من تفاعل الأسترة المحفز بالحامض والأسترة المحفزة بالقلويات باستخدام هيدروكسيد الصوديوم. أظهر مطياف الكتلة بتقنية الكروماتوغرافيا الغازية أن زيت الخروع تم تحويله إلى وقود حيوي.

تم التحقق من الخصائص الفيزيائية والكيميائية للوقود الحيوي وفقاً للمعايير القياسية الأمريكية رقم D6751 و وجد أن الوقود الحيوي قد استوفى جميع المتطلبات القياسية للمعايير. تم اختبار خليط الوقود الحيوي لزيت الخروع مع الديزل الأحفوري رقم D20 وفقاً للمواصفات الأمريكية رقم D7467 ونجح في اجتياز متطلبات المعيار.

كما تم تحضير نوعين من خليط الوقود الحيوي، و بحيث يمثل الخليط الاول الوقود الحيوي 20% و 80% من الديزل، والثاني عبارة عن 20% من الوقود الحيوي و 60% من الديزل و 20% من الإيثانول و تمت مقارنة بالمعيار الأمريكي رقم D7467. و جدد ان الخليطين مستوفيين للمواصفات القياسية باستثناء اختبار اللزوجة ، حيث وجد ان درجة اللزوجة للوقود الحيوي تساوي 17.37 درجة مئوية و هي اعلي من المعيار الأمريكي. و كانت قيمة الرقم الحمضي 0.6 mg/KOH وهي أعلى بقليل من المعيار الامريكي.

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List of Abbreviations

ASTM	American Standard for Testing And Materials
EN	European Standards
AOCS	American Oil Chemist Society
GWh	Glossary Gigawatt hours
GHGs	Greenhouse Cases
IGCC	Integrated Gasification Communed Cycle
CSP	Concentrating Solar Plant
ELCA	Energy Life Cycle Analysis
NER	Net Energy Ratio
FAME	Fatty Acid Methyl Ester
FFA	Free Fatty Acid
CP	Cloud Point
PP	Pour Point
CFPP	Cold Filter Plugging Point
CSP	Communicating sequential processes.
TGA	Termo-Gravimetric Analysis
ICP	Inductively Coupled Plasma Spectroscopy
FTIRS	Fourier-Transform Infrared Spectroscopy

GC-MS	Gas Chromatography- Mass Spectroscopy
DCN	Derivative Cetane Number
ID	Ignition Delay
IQT	Ignition Quality Tester
TIRS	Toxics Release Inventory System

CHAPTER ONE

INTRODUCTION AND LITERATURE REVIEW

CHAPTER TWO

MATERIALS AND METHODS

CHAPTER THREE

Results and Discussions

Reference