

Dedication

I dedicate this effort to:

The Soul of My father's

...My Mother ,

Sisters

and

Uncle

ACKNOWLEDGEMENT

Above all, praise is to *Allah* who has sustained me throughout this work.

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Abstract

Biodiesel produced from *Jatropha curcus L* fixed oil by trans-esterification process represents one of the most alternative fuel options to replace depleting fossil fuels.

Physico-chemical parameters such as density, kinematic viscosity, flash point, cloud point, ash content, sulphur content, water content, colour, copper strip corrosion, carbon residue and cetane number, were determined for diesel fuel samples (S1, S2, S3 and S4). Results obtained were within the limits assigned by American Society for Testing and Materials (ASTM) except the water content of sample (S1) was found to be 0.052 % w/w. the cetane number was found to be 56.14, 54.72, 57.89 and 56.9 for samples S1, S2, S3 and S4, respectively.

The *Jatropha curcus* oil was converted to biodiesel using two methods:

-in the presence of homogenous base catalyst (oil: methanol: NaOH) optimum molar ratio (1:3:0.1) the yield was (96.95%) , at 65°C for 2 hours.

-in the presence of heterogeneous catalyst microporous natural zeolite (natrolite, $\text{Na}_2\text{Al}_2\text{Si}_3\text{O}_{10}\cdot 2\text{H}_2\text{O}$), optimum molar ratio [(1:3:0.2), oil: methanol: natrolite)], the yield was 70.9%.

Physico-chemical parameters as for petrodiesel and biodiesel were determined. Organic and elements composition of oil, biodiesel and petrodiesel were, also, evaluated.

Cetane number of biodiesel and petrodiesel, after treatment with furfural, have been improved from 60.8 to 64.1 and from 54.46 to 58.36, respectively. Improvement accomplished by the eco-friendly blend furfural has removed 13 and 81 aromatic, cyclic and branched organic compounds from biodiesel

and petrodiesel respectively, Such compounds exhibits a negative effect on the cetane number of diesel fuel. In the case of petrodiesel sample after treatment by furfural have shown a decrease in the elements composition of Na, Mg, K, Fe, Al and As, the result led to the decrease of ash content.

Conversion process adopted using gamma radiation has slightly improved the cetane number from 60.8 to 61.2 and 61.9 of *Jatropha curcus* biodiesel under the doses 3KGy and 6KGy, respectively, but the cetane number was decreased after been exposed on 10KG.

The value obtained from *Jatropha* biodiesel closely matched the value of conventional diesel as the (ASTM) and as it been used in the existing diesel engines without any modification.

المستخلص

يعتبر وقود الديزل الحيوي المنتج من زيت بذرة نبات حب الملوك (الجاتروفا) من خلال عملية الاسترة أكثر خيارات الوقود البديلة للحد من الحاجة إلى استنزاف الوقود الأحفوري. وقد أدى هذا الدافع إلى إنجاز هائل في البحث الحالي. الخصائص الفيزيوكيميائية مثل الكثافة ، اللزوجة ، درجة الوميض ، درجة السحابية ، نسبة الرماد ، نسبة الكبريت ، نسبة الماء ، وتآكل قطاع النحاس ، نسبة المتبقي من الكربون والرقم السيطني ، كل هذه الإختبارات جرت علي عينات من وقود الديزل الاحفوري (S1، S2، S3، S4). النتائج المتحصل عليها وجد انها تتفق مع الحد المسموح به من الهيئة الأمريكية لطرق وإختبار المواد ما عد نسبة الماء للعينة (S1) وجد انها تساوي **0.025 % (وزن/وزن)**. وجد ان الرقم السيطني لكل من S1,S2,S3,S4 يساوي **56.14** و **54.72** و **57.98** و **56.9** ، علي التوالي.

زيت نبات الجاتروفا تم تحويله الي وقود حيوي وتم تحضيره بطريقتين :

- باستخدام عامل حفاز قاعدي متجانس (زيت : ميثانول : هيدروكسيد الصوديوم) ووجد ان النسبة المولية المناسبة هي (1:3:0.1) ، علي التوالي وبنسبة ناتج **96.95%** في درجة **65 م⁰** لمدة ساعتان.
- باستخدام عامل حفاز غير متجانس الزيولايت (الناترولايت) ، $(Na_2Al_2Si_3O_{10}.2H_2O)$ ونسبة المولية القياسية وجد انها تساوي (1 : 3 : 0.2) ، زيت: ميثانول، ناترولايت مع نسبة ناتج **70.9%**.

نفس الخواص التي تم قياسها علي الديزل الاحفوري تم قياسها علي الوقود الحيوي ، كما أن التركيب التركيب العضوي و المعدني لكل من زيت الجاتروفا والوقود الحيوي والديزل الاحفوري تم التعرف عليهم.

الرقم السيطني لكل من الوقود الحيوي والديزل الاحفوري قد تم تطويره من **60.4** الي **64.1** و من **54.46** الي **58.36** ، علي التوالي. والتطوير بواسطة اضافة الفورفيوال ازال **13** و **81** من الوقود الحيوي والديزل البترولي ، علي التوالي ، ومعظم هذه المركبات اروماتية، حلقيه ، ومتفرعه وهي بدورها تعطي نتائج سالبة علي خصائص وقود الديزل الاحفوري. وفي عينة الديزل البترولي وجد ان تراكيز بعض العناصر مثل **Na, Mg, K, Fe, Al** و **As** قد انخفضت بعد الخلط مع الفورفورال وهذه النتيجة تقود الي نقصان نسبة الرماد.

طريقة التحويل التي أجريت علي الوقود الحيوي باستخدام أشعة جاما قد طورت من الرقم السيطني عند جرعه **3** كيلوقري و **6** كيلوقري ، ولكن حدث نقصان في الرقم السيطني بعد تعريض العينة الي **10** .

والنتائج المتحصل عليها من الوقود الحيوي تتفق تماما مع الخصائص الموضوعه بواسطة الهيئة الأمريكية لطرق وإختبار المواد ومصفاة الخرطوم، مما يعني انها صالحة لتشغيل ماكينات الديزل من دون أي تعديل.

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List of abbreviations

CO ₂	Carbon di oxide
Fig	Figure
R	Alkyl group
Kg	Kilo gram
L	Litter
FFA	Free Fatty Acids
ER	Eley-Rideal
LH	Langmuire Hinshel
TG	Triglyceride
CA ₀	Bulk concentration
CAs	Concentration on Catalyst surface
°C	Degree centigrade
SCE	Supercritical carbon dioxide extraction
FAME	Free Fatty Acids Methyl Ester
CN	Cetane Number
IV	Iodine Value
ASTM	American Society for Testing and Materials
API	American Petroleum Institute
US	United State
LPG	Liquefied Petroleum Gas
OECD	Organisation for Economic Co-operation and Development
VGO	Vacuum Gas Oil
FCC	Fluid catalytic cracking
DTBP	Di-tertiary butyl peroxide
US.EPA	United States Environmental Protection Agency
EM	Electromagnetic
UV	Ultra Violet
Hz	Hertz
Å	Angstrom
GC-MS	Gas Chromatography Mass Spectrometry Technique
ICP	Inductively Coupled Plasma
NMR	Nuclear Magnetic Resonance
AR	Analytical Reagent
ELAN	Software program
DSQ	Disability Studies Quarterly
SO ₂ *	Excited sulphur dioxide
KGy	Kilo Gray
KH	Khartoum Refinery