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By

AWAD, W.I., MIKHAIL, S.S., WASSEF, W.N., AGAMI, S.M.

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POSSIBLE RENEWABLE ENERGY FARMS IN ARID AND SEMI-ARID AREAS

Studies on Some Egyptian Indigenous Euphorbia and Calotropis Asclepiadaceae For Energy Purposes.

By

AWAD, W.I.*, MIKHAIL, S.S.**, WASSEF, W.N.* AGAMI, S.M.*

* Department of Chemistry, University College for Women, Ain-Shams University, Heliopolis, Cairo, Egypt.

** Egyptian Petroleum Research Institute, Nasr City, Zairo, Egypt.

SYNOPSIS

Some indigenous arid plants* namely *E. Lactea*, *E. Nubica*, *E. Mauritanica*, *E. Neriifolia*, *E. Synadenium grantii* and *E. Psedocactus* from the Euphorbeacea family and *Procera*, from the *Calotropis Asclepiadaceae* were dried and extracted aiming at petrol substitute. The analytical data, i.r., n.m.r., catalytic cracking and chromatographic separation as well as the calorific value were determined.

INTRODUCTION

The world is now facing depleting fossil fuel, viz. petrol, gas and coal. The petrol and gas are expected to vanish from our planet near 2050 while coal can remain for further 300–400 years more¹. Thus, sooner or later human beings are going to return to nature viz. biomass to search for fuel particularly liquid ones.

Places like Egypt, where most of the land (95 %) are deserts or desertlike, should utilise these areas in cultivating arid and semi-arid plants. Lucky enough, some of these plants e.g Euphorbiaceae, fix the energy of sunlight via photosynthesis in the form of hydrocarbons^{2,3}. This is the aim of this work, with special references to indigenous plants⁴.

* These plants were supplied by the Egyptian Desert Institute.

RESULTS AND DISCUSSION

The dried plants were ground and a known weight of each type was extracted first by non-polar solvent (petroleumether 60-80) and then by a polar solvent (methanol) by simple soxhlet extraction technique. The solvent was driven off and the residue was investigated.

From the Euphorbiaceae family; *E. Lactea*, *E. Nubica*, *E. Mauritanica*, *E. Neriifolia*, *E. Synadenium grantii* and *E. Pseudocactus* are indigenous plants. The seeds of *E. Lathyris* were supplied by Prof. Melvin Calvin and cultivated in our area. *Procera*, from another family (*Calotropis Asclepiadaceae*) was also investigated.

Table (1) indicates that the amount of extractable soluble fraction was greater when using methanol (polar solvent) than the non-polar solvent i.e pet. ether. The opposite was true for the carbon, hydrogen percentage.

The average percentage of the extractable soluble fraction ranged between 4.50 to 10.80 for pet. ether and the corresponding percentage for methanol was 4.80 to 18.00.

On the other hand, the percentage of carbon hydrogen ranged from 80 to 88.48 for pet. ether as compared with 23.70 to 47.34 for methanol. Table (1) also illustrates the principle active functional groups of the extractable fractions through the infra-red analysis where an O-H, C-H, C=O stretching frequencies are recorded.

The nuclear magnetic resonance of *E. Lactea* and *E. Mauritanica* (pet. ether extract) were carried out. The study revealed that most of the hydrocarbons are of aliphatic nature (δ between 0.7 and 1.6 ppm).

The effect of sea water dilutions on the hydrocarbon content of *E. Mauritanica* was investigated- A pot experiment was carried out at the Egyptian Desert Institute in 1982. Four levels of sea water dilution were used: Fresh water, 25 % sea water + 75 % fresh water, 50 % sea water + 50 % fresh water and 75 % sea water + 25 % fresh water. Data of table (2), indicate that plants irrigated with 50 % saline water show increase in the extractable pet. ether soluble fraction and in the carbon, hydrogen percentage.

The catalytic cracking of *E. Mauritanica* and *E. Lactea* was carried out by arranging the required weight of the plant extract alternatively with γ -alumina catalyst and placing it in the hot zone of the reactor.

Table 1. Extracts of Different latex species with non-polar and polar solvents.

Family Name	Euphorbiaceae				Asclepiadaceae			
	E. Lathyrus	E. Lactea	E. Mauritan	E. Nerufoia	E. Nubica	Synadenium Grantii	E. Pseudo- cactus	Calotropis procera
Pet. ether (60-80) Soluble fraction % Z, H % Functionality (cm ⁻¹) νOH νCH νC=O	4.50 80.90 3450 broad 2920-2860 1725	6.50 88.48 3480 broad 2920-2855 1750	5.13 86.88 3450 broad 2920-2845 1760	7.2 80.0 3450 broad 2920-2845 1720	7.5 81.70 3450 broad 2920-2845 1740	10 84.30 3450 broad 2920-2845 1745	10.8 81.50 3450 broad 2920-2845 1740	5.00 80.73 3450broad 2920-2845 1730
Methanol extract % C, H % Functionality (cm ⁻¹) νOH νCH νC=O	10.12 24.90 3400 broad 2925-2850 1700	10 31.88 3400 broad 2925 1625	4.8 47.34 3400 broad 2925-2850 1700	12.30 39.40 3400 broad 2920-2845	8.3 44.00 3400 broad 2920-2845 1740	15 32.50 3350 broad 2920-2845 1730	18 23.70 3400 broad 2920-2845	6 39.10 3405broad 2925 1625

Table 2. Hydrocarbon content of *E. Mauritanica* as affected by irrigation of different levels of sea water.

	100 % water	75 % water 25 % saline water	50 % water 50 % saline water	25 % water 75 % saline water
Water %	81.6	79.5	75.4	72.2
Pet. ether (60-80) soluble fraction %	7.65	9.4	9.7	6.66
C, H %	88.6	84.9	91.5	88.3
Functionality (cmat)				
ν_{OH}	3400 ^a	3400 ^a	3400 ^a	3400 ^a
ν_{CH}	2910-2840	2910-2845	1920-2845	2910-2840
$\nu_{C=O}$	1710	1710	1710	1710
Methanol extract %	13.2	8.49	8.73	8.4
C, H %	42.7	41.2	40.3	37.7

a) Broad band

The reactor was heated slowly in a stream of purified nitrogen gas (60 ml/min), flow under atmospheric pressure up to 450 C. At the end of the reaction, the liquid product was condensed and collected in the receiver and analysed by gas-liquid chromatography (cf. Fig. 1 and 2).

The infra-red spectrum (neat) for the cracked product collected below 250 C (low yield) shows only stretching frequencies for alkanes at 2885 cm^{-1} , 2920 cm^{-1} , 2940 cm^{-1} and 1460 cm^{-1} .

The infra-red spectrum for the cracked fraction (neat) between 250 and 450 C (main yield) showed ν_{OH} at 3500 cm^{-1} broad base and weak band, ν_{CH} at 280-2980 cm^{-1} very strong, $\nu_{C=O}$ at 1710 cm^{-1} (weak) and out of plane bending for aromatic compounds at 720 and 810 cm^{-1} .

When diluted with chloroform the ν_{CH} splitted into two strong bands at 2845 cm^{-1} and 2920 cm^{-1} for alkanes and, a medium band at 3010 cm^{-1} for ν_{CH} aromatic.

The heat of combustion of the cracked liquid product was determined by using a "Ballistic bomb calorimeter apparatus".

The caloric values of the products collected from 250 to 450 C, for *E. Mauritanica* and *E. Lactea* are 10.266 Kcal/g and 10.144 K cal/g respectively. It is clear from this investigation that the investigated plants are a reasonable source for petrol substitutes. The yield of the extractable product from the wild plants is expected to increase via agronomical and tissue culture studies. The cracking pattern and the calorific value are within reason for liquid fuel.

The salt water irrigation results are of extreme importance as many parts of Egyptian deserts have underground water (salty in nature) which cannot be used for conventional plantation but can be successfully used for cultivation of *E. Mauritania*.

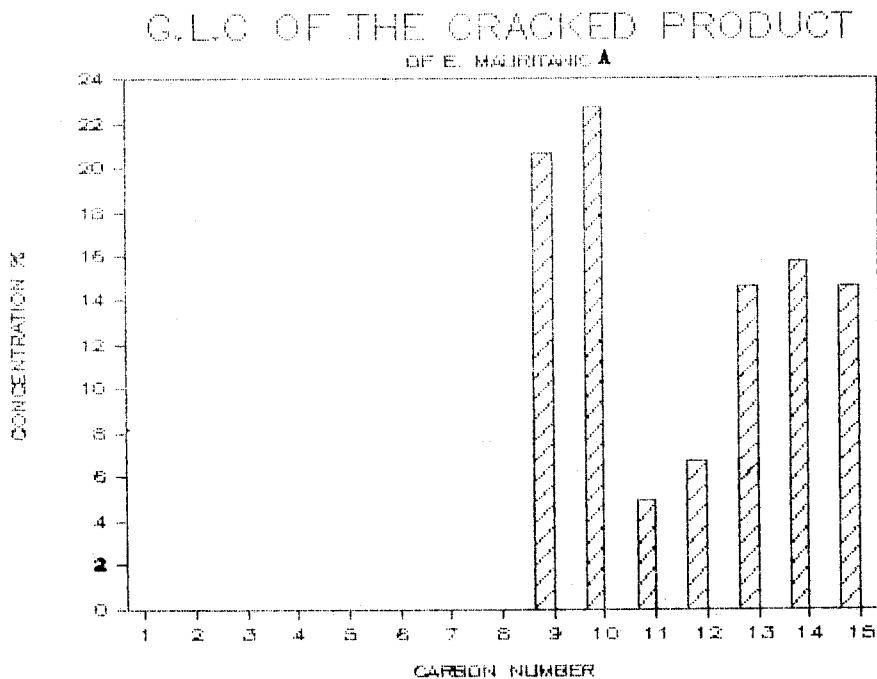


Fig. (1)

GAS-LIQUID CHROMATOGRAPHY OF THE CRACKED PRODUCT OF *E. MAURITANICA*

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	CARBON NUMBER
								20.64	22.76	4.89	6.67	14.64	15.77	14.63	CONCENTRATION (%)

Column: st. st tubing 7 Ft int $\text{\textcircled{D}}$ 1/8

Packing: 5 % Bentane 34/5 % Diisodecyl phthalate on chromosorb p80-100 mesh

Temp. progrs, 100-160 °C

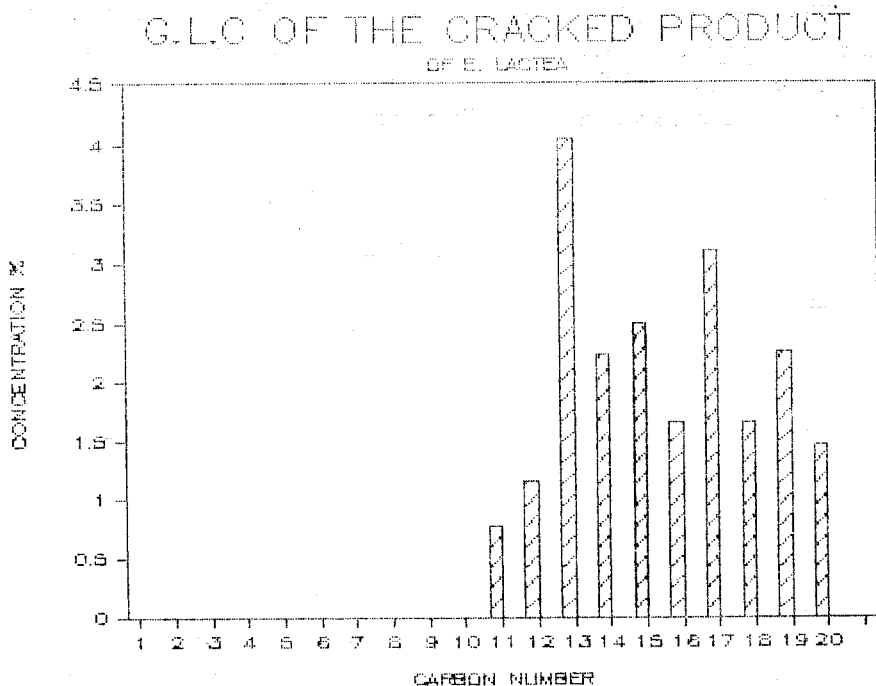


Fig. (2)

GAS-LIQUID CHROMATOGRAPHY OF THE CRACKED PRODUCT OF E. LACTEA

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	OVER 20	Carbon No.
										0.78	1.16	4.05	2.23	2.49	1.65	3.11	1.65	2.25	1.47	79.17	Concentration %

Column: st. st. tubing 7 Ft int % 1/8

Packing: 5 % Bentane 34/5 % Diisodecyl phthalate on chromosorb P80-100 mesh

Temp. progrs. 100-160 C

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