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Utilization of *Colocynth* (Handal) Seeds Oil as a Lubricating Base Oil

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ABSTRACT

This study investigated the use of *Colocynth* seeds oil as lubricating base oil. The *Colocynth* seeds were collected from Eastern Gezira and Western Kordofan. Viscosity index is 162 and 164; Flash point is 292ºC and 288ºC for Eastern Gezira and Western Kordofan samples, respectively. The pour point is -3ºC for both samples. At 40ºC, the kinematics viscosity is 34.37 cSt and 32.69 cSt, and at 100ºC is 8.00 cSt and 7.77 cSt for Eastern Gezira and Western Kordofan samples, respectively. The study suggested that the *Colocynth* seeds oil is a suitable base fluid to produce lubricants.

Keyword: Colocynth seeds, Lubricating, oil, Eastern Gezira, Western Kordofan.

INTRODUCTION

There has been a steady increase in the demand for environmentally friendly lubricants, due to unfavorable impacts on the environment by mineral oil based lubricants. The technical progress taking place in industry and agriculture, has caused an intensive exploitation of natural resources like mineral oil. The search for environmentally friendly, renewable and unlimited sources to replace the fuel and energy sector, has become essential

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(Erhan, 2005). Renewable resources like seed oils and their derivatives are being considered as potential replacements for mineral oil base stocks in certain lubricant applications. It is nontoxic, readily biodegradable, have a high viscosity and has a reasonable cost when compared to synthetic fluids (Mackenzie and Taylor, 1992; Erhan, 2005). On the negative side a high degree of multiple C-C unsaturation in the fatty acid chain of many vegetable oils causes poor thermal and oxidative stability and confine their use as lubricants (Adhvaryu and Erhan, 2002).

Vegetable oils, such as rapeseed oil and high oleic acid sunflower, are thought to be the best candidates to substitute for conventional petrol-based lubricating oils, as well as synthetic esters (Randles, 1992; Asadauskas *et al*, 1996). On the other hand, high demands of the world for oils and fats to meet the multiplied human consumption as edible oil restrict the industrial demand. The use of non edible oils as natural sources in production of lubricant is contributed for satisfaction industrial demand.

The *Colocynth* seed oil (inedible oil), also known as bitter apple (Alhandal) and classified as *Citrullus Colocynthis* is a wild plant widely distributed in the northern, western, eastern and central parts of Sudan (Abdallah, 1997). The oil content of *Colocynth* is 20% (Alwathig, 1990)**.** The fatty acid composition of *Colocynth* is close to the fatty acid composition of sunflower (Abdallah, 1997).

The objective of this paper is to study the possibility of using inedible, *Colocynth* seeds oil (renewable resources) as lubricating base oil.

MATERIALS AND METHODS

Samples of *Colocynth* seeds were obtained from Eastern Gezira (central of Sudan, to represent the seeds that are grown in muddy soil) and Western Kordofan (western Sudan, to represent the seeds that are grown in sandy soil). The *Colocynth* seeds were subjected to mechanical extraction using ZX10 expellers. The kinematics' viscosity was determined according to the American Standard Testing Method (ASTM) number D445 made in 2004. The Viscosity Index (VI) was determined according to ASTM number D2270 made in

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2004. The Flash point was determined according to ASTM number D93 made in 2002. The density and relative density of viscous oils were determined according to ASTM number D4052-96 (Reproved in 2002). The pour point was determined according to ASTM number D97-04.

RESULTS AND DISCUSSION

Table 1 and Fig. 1 show the Kinematic Viscosity of *Colocynth* Seeds Oil. At 40 ºC and 100 ºC, the Kinematics' Viscosity of Eastern Gezira *Colocynth* seeds oil was 34.369 cSt and 8.00 cSt, respectively, which was higher than the Kinematics' Viscosity of Western Kordofan *Colocynth* seeds oil (32.69 cSt and 7.77 cSt, respectively). As compared to the results obtained from Tapcco Company (TO), the results show that the Kinematics' Viscosity of *Colocynth* seeds oil is suitable for lubricant's base oil. Moreover, the Kinematics' Viscosity of *Colocynth* seeds oil is suitable for lubricant's base oil as compared to those reported by Mackenzie and Taylor, (1992) for different vegetable oils compared to 100 neutral oil. However, this kinematics' viscosity is equivalent to 150N base fluids for mineral oil, and assumed to be acceptable when compared to the result reported by Iran Petrochem, (2009) for Behran base oil N150.

Table 1: The Kinematics' Viscosity of *Colocynth* Seeds Oil

Type of oil	Kinematics' Viscosity (cSt) 40ºC	Kinematics' Viscosity (cSt) 100ºC
EG	34.369	8
WK	32.69	7.77
TO	-	7-11

Note:

- EG : Eastern Gezira *Colocynth* seeds oil
- WK : Western Kordofan *Colocynth* seeds oil
- TO : Tapcco oil

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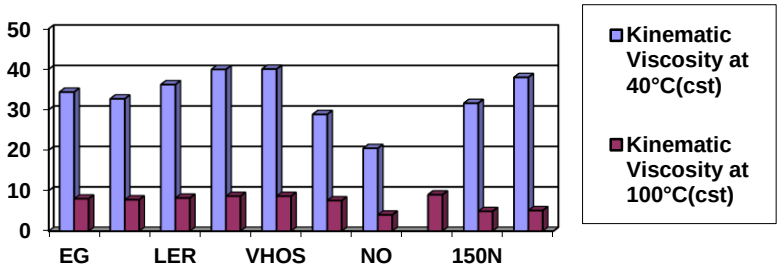

Fig. 1: Comparison of Kinematics' Viscosity at 40°C and 100°C of the different oils. EG: Eastern Gezira *Colocynth* oil**;** WK: Western Kordofan *Colocynth* oil; LER: Low erucic rapeseed oil; HOS: High oleic sunflower oil; VHOS: Very high oleic sunflower oil; SO: Soybean oil; NO: 100neutral oil; TO: The average result of Tapcco oil; 150N: hydraulic lubricant; BO: Behran base oil N150.

The result of the viscosity index are shown in Table (1) and Fig.(1). The viscosity index of Eastern Gezira *Colocynth* seeds oil (162) is lower than the viscosity index of Western Kordofan *Colocynth* seeds oil (164). The results also show that the refractive indexes of *Colocynth* seeds oil are relatively high compared to Behran base oil N150 (Iran Petrochem, 2009), and relatively low as compared to the results reported by Mackenzie and Taylor (1992).

Table 2: The Viscosity Index of *Colocynth* Seeds Oil

Type of oil	Viscosity Index
EG	162
WK	164

Note:
-EG : Eastern Gezira *Colocynth* seeds oil
-WK : Western Kordofan *Colocynth* seeds oil

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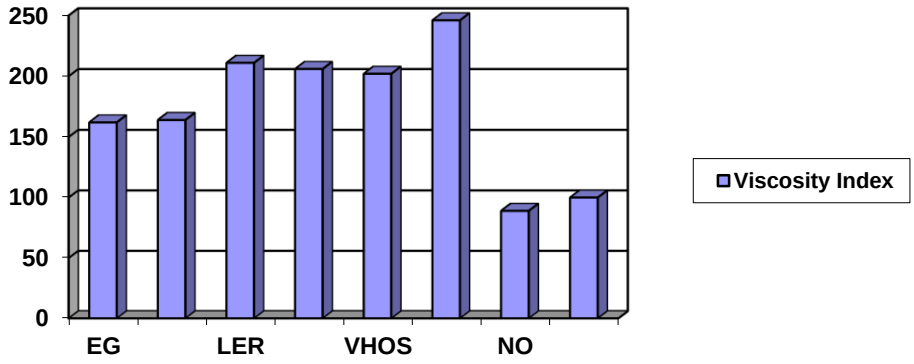

Fig. 2: The Viscosity Index from Kinematics' Viscosity at 40°C and 100°C. EG: Eastern Gezira Colocynth oil**;** WK: Western Kordofan Colocynth oil; LER: Low erucic rapeseed oil; HOS: High oleic sunflower oil; VHOS: Very high oleic sunflower oil; SO: Soybean oil; NO: 100neutral oil; BO: Behran base oil N150.

Table (3) and Fig. (3) show the flash point of different oils . The flash point of Eastern Gezira *Colocynth* seeds oil (292°C) is higher than that of the Western Kordofan Colocynth seeds oil (288°C). Compared to base fluid used by TO and BO, the *Colocynth* seed oil's flash point is relatively high, which means it is safe enough for handling and transportation. Also, it has a good value compared to flash point results for different vegetable oils compared to 100 types of neutral oil (Mackenzie and Taylor, 1992).

Table 3: The Flash Point Results of *Colocynth* seeds and Tapcco oils

Type of oil	Flash point ^{o}C
EG	292
WK	288
TO	240

Note:

-EG : Eastern Gezira *Colocynth* seeds oil

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-WK : Western Kordofan *Colocynth* seeds oil

-TO : Tapcco oil

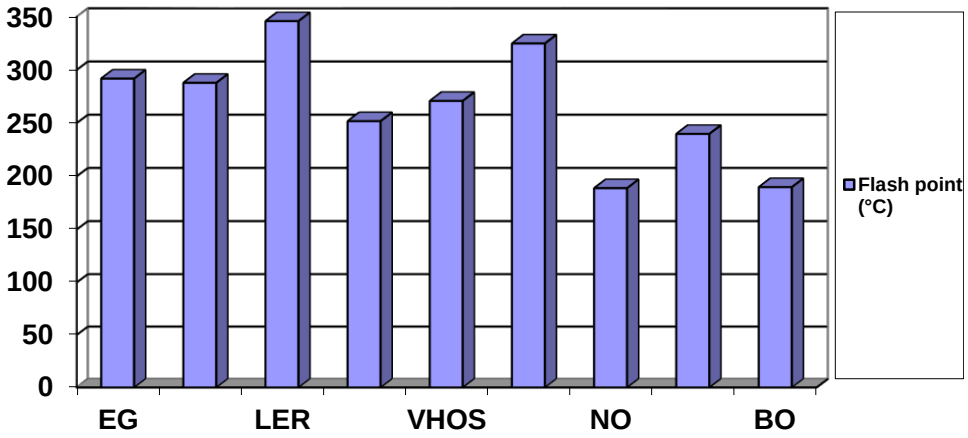

Fig. 3: The Flash Point of different oils. EG: Eastern Gezira Colocynth oil; WK: Western Kordofan Colocynth oil; LER: Low erucic rapeseed oil; HOS: High oleic sunflower oil; VHOS: Very high oleic sunflower oil; SO: Soybean oil; NO: 100neutral oil; TO: Tapcco oil; BO: Behran base oil N150.

Table (4) and Fig. (4) show the density and relative density of the different oils**.** The density and relative density of Eastern Gezira *Colocynth* seeds oil (0.9250 gm/ml and 0.9259 gm/ml respectively), which is higher than that of the Western Kordofan *Colocynth* seeds oil (0.9248 gm/ml and 0.9257 gm/ml respectively). The *Colocynth* seed oil's density and relative density were relatively high compared to the results obtained from TO and BO. Density represented individual parameters in determination viscosity, high-density appear good viscosity.

Table 4: The Density and Relative Density by Digital Density Meter at 15^{o}C

Type of oil	Density g/ml	Relative density

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EG	0.9250	0.9259
WK	0.9248	0.9257
TO	0.888	-

Note:

-EG: Eastern Gezira *Colocynth* seeds oil

-WK : Western Kordofan *Colocynth* seeds oil

-TO : Tapcco oil.

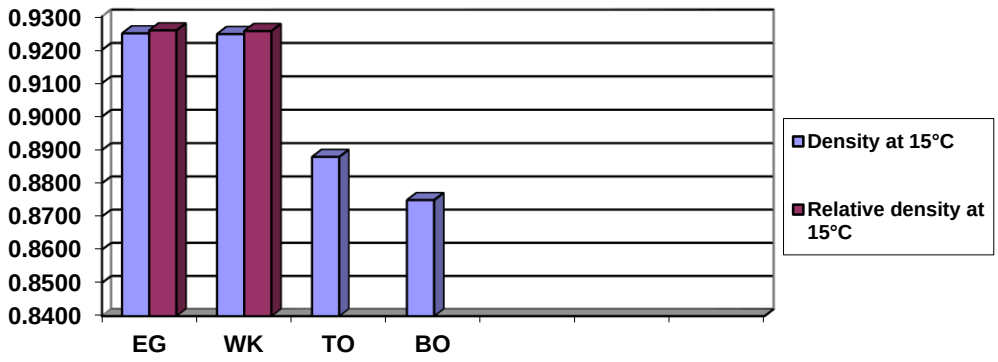

Fig. 4: Density and Relative Density of Liquids by Digital Density Meter. EG: Eastern Gezira *Colocynth* oil**;** WK: Western Kordofan *Colocynth* oil; TO: Tapcco oil; BO: Behran base oil N150.

Table (5) and Fig. (5) show the result of pour point of the oils. The pour point is-3ºC for Eastern Gezira and Western Kordofan *Colocynth* seeds oil. It is clear that the results appear negative value that may affect the usage in cold area compared to those reported by Mackenzie and Taylor, (1992). Generally, the vegetable oils have a low cold's flow behavior.

Table 5: The Pour Point of the *Colocynth* Seeds Oil

Type of oil	Pour Point
EG	-3

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WK	-3

Note:

-EG : Eastern Gezira *Colocynth* seeds oil

-WK: Western Kordofan *Colocynth* seeds oil.

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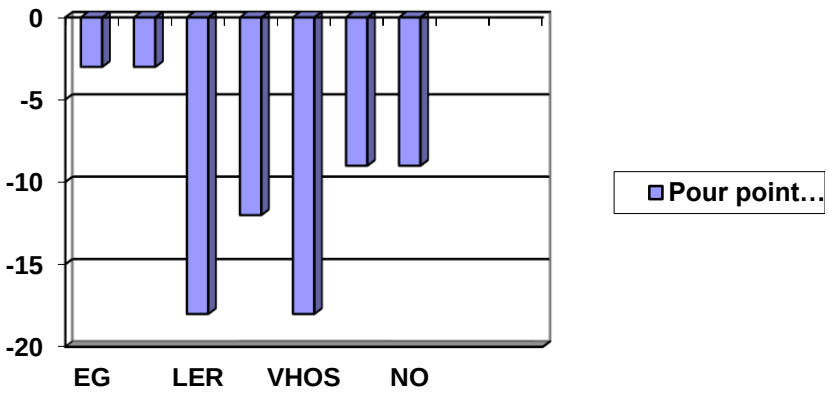

Fig. 5: The Pour Point (°C) of different oils. EG: Eastern Gezira *Colocynth* oil**;** WK: Western Kordofan *Colocynth* oil; LER: Low erucic rapeseed oil; HOS: High oleic sunflower oil; VHOS: Very high oleic sunflower oil; SO: Soybean oil; NO: 100neutral oil.

CONCLUSION

This study succeeded to some extent in determining the preliminary data to accept the *Colocynth* seeds oil as a base fluid for lubricant. The kinematics' viscosity is equivalent to mineral base oils suitable for production of hydraulics lubricant (N150). The degree of change of the *Colocynth* seeds oil with temperature is acceptable (viscosity index is 162 and 164). The flash point results show that *Colocynth* seeds oil is safe in handling. The results of pour point gave a negative value in using *Colocynth* seeds oil in cold areas. The results encourage researchers to continue in this venue either by enhancing the properties of *Colocynth* seeds oil by modification or by blending with other good lubricating vegetable oils.

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