ISSN: 0975-833X

Available online at http://www.journalcra.com

International Journal of Current Research
Vol. 5, Issue, 12, pp.3948-3949, December, 2013

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

RESEARCH ARTICLE

TEMPERATURE DEPENDENCE OF DYNAMIC VISCOSITY OF VEGETABLE OILS: ARGAN, COLZA AND SUNFLOWER

[1]Imane HASSANAIN, *[1]Khouloud LAKRARI, [1]Kaoutar ELLOUZI, [1]Imane ELLOUZI, [2]Said KITANE, and [1]Mohamed ALAOUI El BELGHITI

[1]Laboratoire de Chimie Physique Générale, Département de Chimie, Université Mohammed V-Agdal, Faculté des Sciences, Avenue Ibn Batouta, BP 1014 Rabat

[2]Laboratoires de chimie appliquée à l'Ecole Nationale de l'Industrie Minérale, Avenue Hadj Ahmed Cherkaoui BP 753 Agdal Rabat

ARTICLE INFO

Article History:
Received 22nd September, 2013
Received in revised form
09th October, 2013
Accepted 29th November, 2013
Published online 25th December, 2013

Key words:
Viscosity, Arrhenius-type relationship, Temperature, Activation energy.

ABSTRACT

In this paper, we have studied the effect of temperature on dynamic viscosity of three vegetable oils: argan oil, colza oil and sunflower oil. The effect of temperature on viscosity is fitted with the Arrhenius-type relationship. A plot of Logarithm of viscosity versus 1/T was built for each sample, we have deduced from these curves, the activation energy E_a and the infinite-temperature viscosity (η_∞) for each oil, the correlation constants for the best fit are presented.

INTRODUCTION

Vegetable oils are generally very low toxics and have excellent biodegradability. These qualities are due in particular to a low resistance to oxidation and hydrolysis. Viscosity means the resistance of one part of the fluid to move relative to another one. Viscosity is one of the most important physical properties of a liquid system; the change of viscosity is linked to physicochemical oil properties (Fasina and Colley 2008; Dak *et al.,* 2008; Toth *et al.,* 2007). Furthermore, it is also a factor that determines the global quality and stability of a vegetable oil. From the physicochemical point of view, several studies (Ramakrishna *et al.,* 1987) have been carried out on the viscosity of oils Viscosity can changes with temperature, pressure, and concentration of fluids; all these changes can be modelled by some theorical equations. The variation of the viscosity of used oils with the temperature, is analyzed applying the Arrhenius equation:

$$\eta = A\exp(E_a/RT) \qquad (1)$$

where η is the dynamic viscosity, A is the pre-exponential factor (Pa.s), E_a is the activation energy (J/mol); R is the gas constant (J/mol/K) and T is the temperature (K). The value of A can be approximated as the infinite-temperature viscosity (η_∞), which is exact in the limit of infinite temperature (Noureddini *et al.,* 1992). The, equation (1) can be rewritten in the following form:

$$\ln(\eta) = \ln(A) + (E_a/RT) \qquad (2)$$

The objective of this work is to fit our results by Arrhenius equation, and determine from this modeling, the physicochemical characteristics of the oil studied.

MATERIALS AND METHODS

The viscosity is measured by a viscometer Osswald (http://www.schott.com/labinstruments)**:**

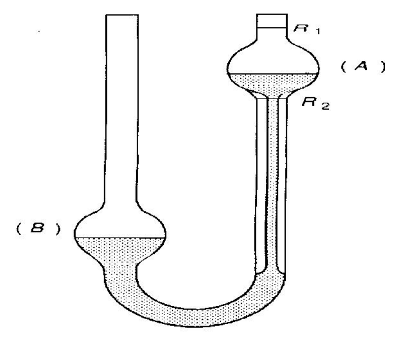

Figure 1. Osswald viscosimeter

***Corresponding author: Khouloud LAKRARI,** *Laboratoire de Chimie Physique Générale, Département de Chimie, Université Mohammed V-Agdal, Faculté des Sciences, Avenue Ibn Batouta, BP 1014 Rabat.*

Measurement of the dynamic viscosity of vegetable oils: Measuring the time of a flow of a volume V of fluid through a capillary tube. The kinematic viscosity is proportional to the flow time:

$$(\eta = k \ \Delta t) \qquad (3)$$

The constant K of the device is given by the manufacturer of the viscometer.

RESULTS AND DISCUSSION

In the present work, we determined the viscosities of some vegetable oils in the temperature range from 283K to 343K. Figures 2, 3, 4, show the dependence of Nepirean-logarithm of viscosity versus temperature of the vegetable oil studied.

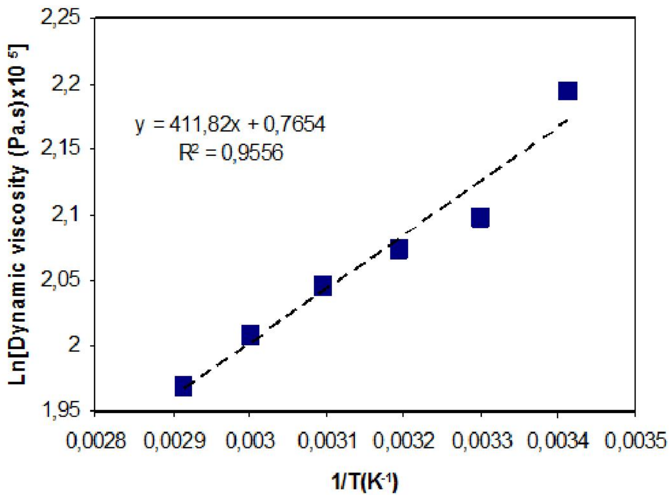

Fig. 2. Dependence of Ln(viscosity) versus temperature of argan oil

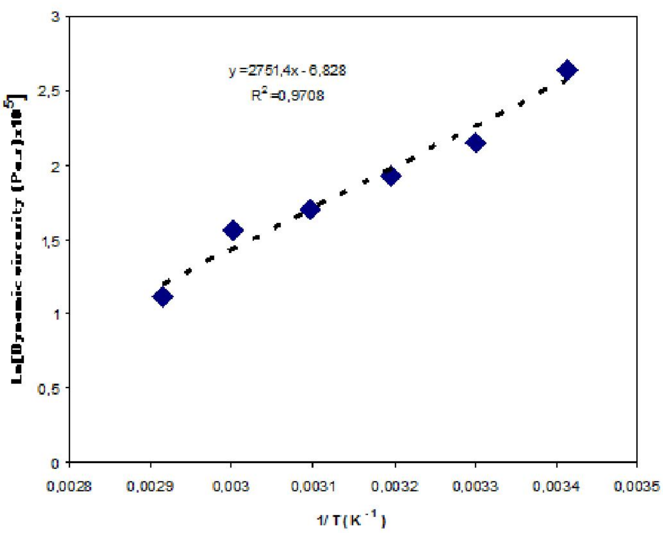

Fig. 3. Dependence of Ln(viscosity) versus temperature of colza oil

From these figures, it can be observed that the dynamic viscosity of the vegetable oil decreases with increasing temperature. We can compute the values of the activation energy E_a and pre-exponential factor A from the slope and y-intercept of this straight line respectively.

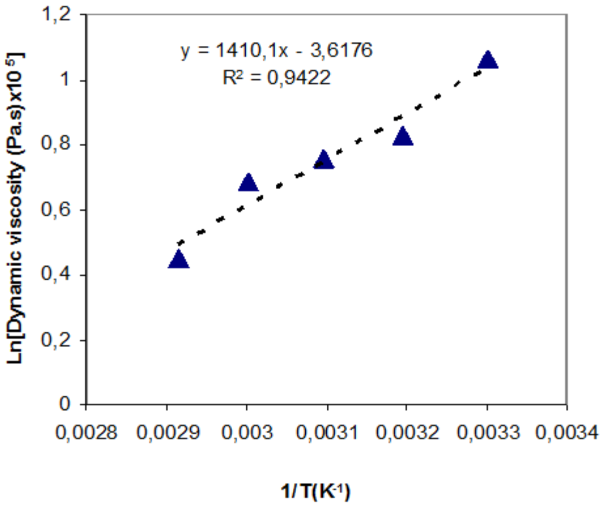

Fig. 4. Dependence of Ln (viscosity) versus temperature of sunflower oil

Table 1. Important parameters of the ln(viscosity) versus temperature fit

sample	A(Pa.s)x106	Ea(kj/mole)	R2
Argan oil	0.21	3.42	0.957
Colza oil	0.01	22.86	0.971
Sunflower oil	0.27	11.72	0.942

In Table 1, we have ploted the important parameters of the ln (viscosity) versus temperature-fit. We can be obtained from this study, the following results: the infinite-temperature viscosity ($\eta\infty$) of the studied vegetable oils are as:

($\eta\infty$) sunflower > ($\eta\infty$) argan > ($\eta\infty$) colza.

The activation energies are as:

(Ea) colza > (Ea) sunflower > (Ea) argan

Conclusion

The temperature dependence viscosity of: argan, colza and sunflower vegetable oils can be adequately described using the classical Arrhenius expression. The activation energy, as well as the pre-exponential term were obtained. These results can be used as a way of characterizing the oil quality. These values depend on oil nature.

REFERENCES

Dak, M., R.C.Verma, M. K. Jain, 2008. *Inter. J. Food Eng.* 4, 1.

Fasina, O.O., Z., 2008. Colley, *Inter. J. Food Prop* 11, 738.

Noureddini H, Teoh BC, Clements LD. 1992. Viscosities of oil and fatty acids. *J. Am. Oil Chem. Soc.,* 69: 1189- 1192.

Ramakrishna, P., K.V.L. Venkatesh, T.C. Poornimaand B. Manohar, 1987. *J.Am.OilChem.Soc.,* 64, 859.

Schott Geräte Operation Instructions Ostwald Viscometer. http://www.schott.com/labinstruments.

Toth, J., Z. Simon, P. Medveczky, L. Gombos, B. Jelinek, L. Szilagyi, L. Graf, A. 2007. Malnasi- Csizmadia, Struct. Function Genet. 67, 1119.

****