STUDIES CONCERNING THE VISCOSITY COEFFICIENT OF SOME VEGETABLE OILS OBTAINED FROM DIFFERENT WALNUT BIOTYPES AND GRAPE SEEDS

STUDII PRIVIND COEFICIENTUL DE VÂSCOZITATE AL UNOR ULEIURI VEGETALE OBTINUTE DIN DIFERITE BIOTIPURI DE NUCI ŞI SEMINŢE DE STRUGURI

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Abstract. *This paper analyses the viscosity coefficient variation of vegetable oils obtained from grape seeds and some walnuts biotypes coming from different geographic regions of Moldavia (Romania). This study proposes a mathematical model, an algorithm for calculating the variation of the viscosity coefficient with the temperature used for determination. Measuring the viscosity coefficient is the first step in a larger study, which considers the investigation of various properties of these horticultural oils, such as: the degree of turbidity, the degree of siccativity, the forces of molecular cohesion. Finally these parameters will be used to achieve a classification system in terms of quality of the grape seed oil and walnut oil.*

Key words*:* viscosity, grapeseed oil, walnut oil

Rezumat. *În lucrarea de față s-a determinat modul de variație a coeficientului de vâscozitate la uleiurile vegetale obţinute din seminţe de struguri şi din nucă aparţinînd unor biotipuri provenite din diferite regiuni geografice din zona Moldovei (România). Studiul de faţă propune un model matematic, un algoritm de calcul al variaţiei coeficientului de vâscozitate cu temperatura la care acesta a fost determinat. Măsurarea coeficientului de vâscozitate este prima etapă dintr-un studiu mai larg ce are în vedere investigarea diverselor proprietăti ale acestor uleiuri horticole, precum: gradul de turbiditate, gradul de sicativitate, forţele de coeziune moleculară. În final acești parametri vor fi utilizați pentru realizarea unui sistem de clasificare din punct de vedere calitativ a uleiurilor din seminţe de struguri şi de nucă.*

Cuvinte cheie*:* vâscozitate, ulei din semințe de struguri, ulei de nucă

INTRODUCTION

The edible vegetable oils are characterized by physical and chemical properties that give their favorable quality note. Among these properties the viscosity coefficient is a very important fact that may have a manifestation at macrofizic level. By its nature, the viscosity coefficient provides information about molecular structure and the type of cohesion forces between atoms / molecules of the analyte (Hristov A., 1990). Also, the coefficient of viscosity is an important indicator of the stability of the test material, indicating whether or not it retains its optimal proprieties in time, to be consumed.

Any degradation of the chemical properties and structure will be directly reflected in the coefficient of viscosity, also. The solid suspensions (inclusions) and/or other foreign substances which the oils may be blended with, will lead directly to change the coefficient η (Manahan Stanley E., 2001) so that by its determination, respectivley finding of any value far from an optimal value we may conclude if or not the oil fits to certain rules.

Of the frequent changes occurring in the chemical structure of the edible oils we mention oxidation and microparticle matter load. Any of the substance and its quality, temperature is vitally important physical parameter affecting the value of the coefficient of viscosity, so that a temperature drop is correlated with an increase in the coefficient of viscosity and vice versa.
In the present study aimed to identify a mathematical algorithm of variation value of the parameter η according to the temperature measurement that was made.

Non-polar molecular structure gives oil characteristics (Luca E., 1993) the interest being that they do not wet the walls of the vessels where are being stored. This shows that between non-polar ends of the constituent molecules and the main glass wall surface interaction forces due to friction between the peripheral layer of liquid and the inner surface of the vessel wall extreme (Luca E., 1993).

The viscosity of the fatty acids and the derived triglycerides is determined by the structure of the fatty acid composition, specially of the composition, length of the chain and the degree of unsaturation.

Viscosity increases proportional to molecular weight of the fatty acids and decreases with the increasing of the unsaturation degree of the same length of chain and it is therefore a linear function for the increasing of the iodine value.

MATERIAL AND METHOD

The oils we studied were obtained from a total of 10 samples of grape seed and walnut, from different localities of E and NE Romania, as follows: Aligote, Iassy; Fetească regală, Iassy; Mustoasă de Măderat, Iassy; Mioriţa, Odobeşti; Merlot, Iassy; Fetească albă, Iassy; Băbească gri, Odobeşti (for grape seeds) and Darabani, Botoţani; Ţibăneşti, Iassy; Vânători, Neamţ (for walnuts).

The grape seed oil was obtained by extraction, by immersing the crushed seeds into the solvent, followed by recovery of the solvent and obtaining of the crude oil. The walnut oil was obtained by pressing, using a mini lab press.

The dinamic viscosity was determined by the laminar flow of fluids using an Ostwald viscosimeter. Experimental data needed to determine the coefficient of viscosity are: time of flowing through the capillary, the temperature of the sample and the density of each oil sample.

To determine the coefficient of viscosity of the control (sunflower oil) we used the Stokes method for each temperature at which were determined the parameters by Ostwald method.

The viscosity coefficient determined by Stokes method is used as control for calculating the viscosity (η) by Ostwald method – where may be used only small quantities of oil.

RESULTS AND DISCUSSIONS

After we effectuated the determinations we obtained the curve of dependency of viscosity coefficient by temperature. We may see a linear dependence of the coefficient η in the same time with the increasing of the temperature (table 1). The deviations from linearity are most likely errors caused accidentally.

Table 1

The coefficient of viscosity of the sunflower oil (control), grapeseed oil (Băbească gri, Odobeşti) and walnut oil (Vânători, Neamţ)

T(°C)	η (T) sunflowwer oil (control)	η(T) grape seed oil	η(T) walnut oil
25	77,1	38,98652	61,8132
30	75,85	38,82564	58,29039
35	69,21	38,0278	56,87887
40	67,92	35,12709	58,15809
45	61,79	33,54313	52,56525
50	54,65	34,02568	47,17029
55	53,86	33,8945	47,62364
60	49,65	28,40704	45,37075

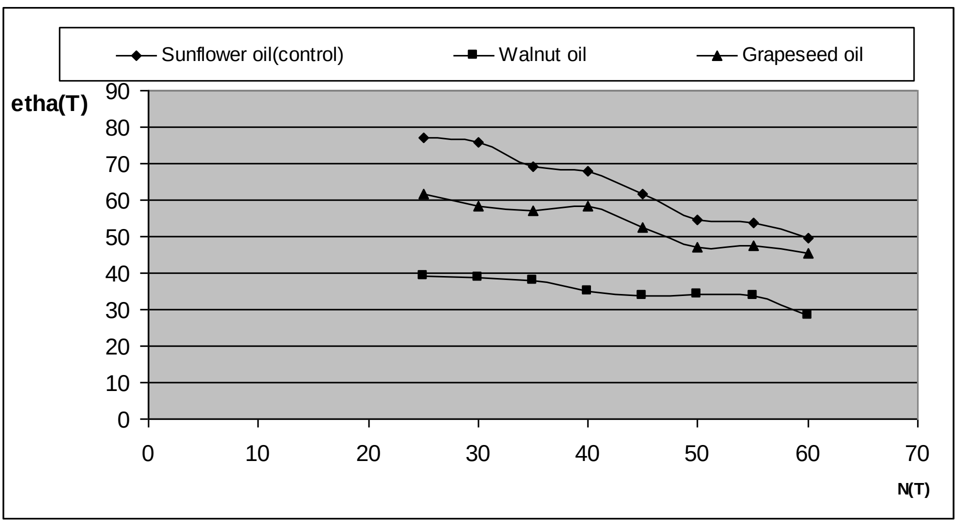

Fig. 1. The variation of the viscosity coefficient with temperature

Linear variation of coefficient η depending on temperature can be modeled by knowing a specific constant of the analysed fluid (table 2). With this constant we may easily model the punctual changes of the viscosity.

The mathematical model proposed is applicable in this case also for the used temperature range (fig. 1).

Due to this type of variation, for each of the three determinations (sunflower oil, grape seed oil, walnut oil), we could implement the following algorithm:

$$\eta = \eta_0 - N \times \upsilon,$$

where :
η: coefficient of viscosity;
η_0: initial value of the coefficient of viscosity;
N: variation index of the temperature parameter;
υ: linearity coefficient

Using the linear equation we could show the changes in viscosity for the entire spectre of temperatures in the range considered (fig. 2).

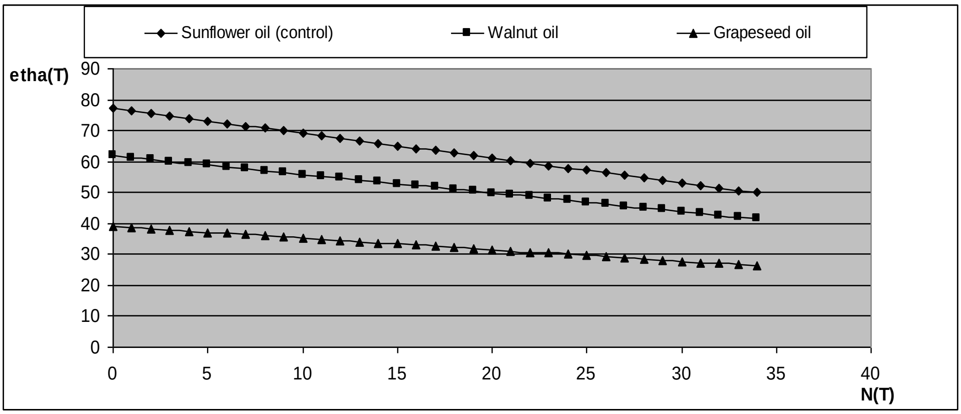

Fig. 2. The liniar variation of viscosity coefficient with temperature

Table 2

Variation with temperature of the viscosity coefficient determined punctual, depending on the sunflower oil (control)

The index of the temperature variation (N)	The sunflower oil (control) coefficient of viscosity (daP)	The walnut oil (control) coefficient of viscosity (daP)	The grape seed oil (control) coefficient of viscosity (daP)
0	77,1	61,8132	38,98652
1	76,3	61,2132	38,61152
2	75,5	60,6132	38,23652
3	74,7	60,0132	37,86152
4	73,9	59,4132	37,48652
5	73,1	58,8132	37,11152
6	72,3	58,2132	36,73652
7	71,5	57,6132	36,36152
8	70,7	57,0132	35,98652
9	69,9	56,4132	35,61152
10	69,1	55,8132	35,23652
11	68,3	55,2132	34,86152
12	67,5	54,6132	34,48652

13	66,7	54,0132	34,11152
14	65,9	53,4132	33,73652
15	65,1	52,8132	33,36152
16	64,3	52,2132	32,98652
17	63,5	51,6132	32,61152
18	62,7	51,0132	32,23652
19	61,9	50,4132	31,86152
20	61,1	49,8132	31,48652
21	60,3	49,2132	31,11152
22	59,5	48,6132	30,73652
23	58,7	48,0132	30,36152
24	57,9	47,4132	29,98652
25	57,1	46,8132	29,61152
26	56,3	46,2132	29,23652
27	55,5	45,6132	28,86152
28	54,7	45,0132	28,48652
29	53,9	44,4132	28,11152
30	53,1	43,8132	27,73652
31	52,3	43,2132	27,36152
32	51,5	42,6132	26,98652
33	50,7	42,0132	26,61152
34	49,9	41,4132	26,23652

For the oils obtained from the following sources: Aligote, Iassy; Fetească regală, Iassy; Mustoasă de Măderat, Iassy; Mioriţa, Odobeşti; Merlot, Iassy; Fetească albă, Iassy; (for the grape seeds) and Darabani, Botoşani; Ţibăneşti, Iassy (for walnuts) we determined the viscosity coefficient at two points of temperature in the range studied: 25°C, respectively 55°C (table 3).

Tabel 3

Variation with temperature of the viscosity coefficient determined for 25°C, respectively 55°C

Oil sample- sources	η(T)		N(T)
	η(25ºC)	η(55ºC)	
Darabani, Bt	75,29266	70,38991	0,162602
Ţibăneşti, Is	76,59937	71,15116	0,156
Aligote, Is	79,54025	75,55388	0,121615
Fetească regală, Is	71,52895	66,31569	0,153
Mustoasă de Măderat, Is	89,65773	69,15627	0,576667
Mioriţa, Odobeşti	68,01586	59,44067	0,24667
Merlot, Is	98,05117	67,98822	0,88
Fetească albă, Is	85,39492	67,12439	0,5191

The tangent determined from the slope that represent the variation of viscosity coefficient with temperature is the coefficient who provides information about dependence of the physical property in each point of temperature according to linear equation (fig. 3).

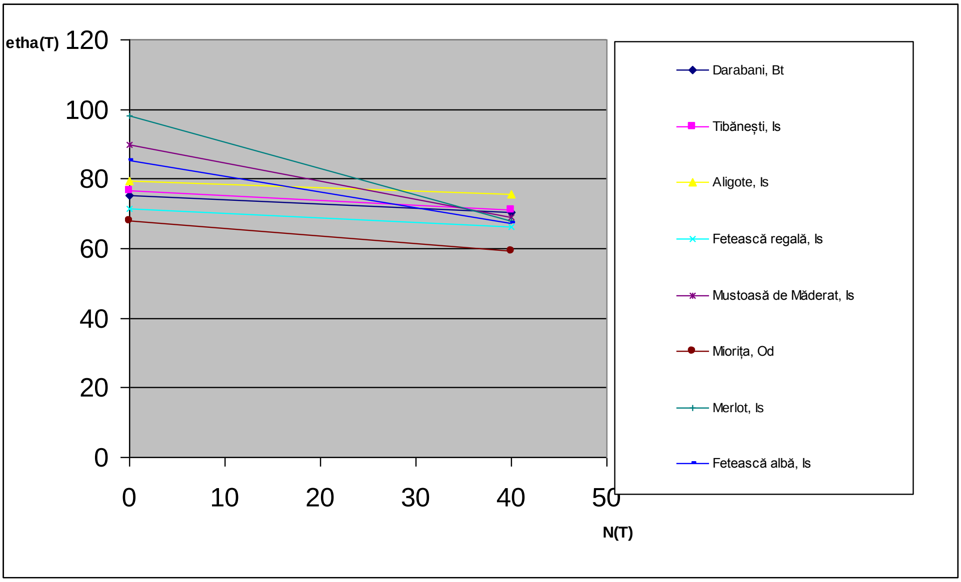

Fig. 3. The variation of the viscosity coefficient with temperature determined point by point using the linear equation for 25-60°C temperature interval.

CONCLUSIONS

1. The mathematical modeling of the variation of the viscosity coefficient helps to comparing the experimental results with the modeled point results and therefore help for a good correlation of data.

2. For the temperature range between 25-60°C, the variation of the viscosity coefficient for the analyzed oils decreases linearly in the same time with the increasing of temperature.

3. The constant determined from the slope of the graphic implies a variation in the percentage of the fatty acids composition in the analysed oils.

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