COMPARATIVE STUDIES OF VARIATION OF COEFFICIENTS OF VISCOSITY OF SOME LOCAL OILS WITH TEMPERATURE

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Abstract

The variation of coefficients of viscosity with temperature for three local oils (palm kernel oil, melon oil and soya beans oil), have been investigated. Poiseuillc's method of determining viscosity and the Ostwald's viscometer method of comparing viscosity were used. Results showed that coefficients of viscosity decrease linearly with temperature rise for the three oils. U was also observed that the viscosity of soya beans oil was higher than that of the other two oils for the temperature range considered.

Introduction

Edible local oils produced in Nigeria belong to the homologous series of fats and oils, which have similar chemical characteristics (Avwiri and Peter 1996). The viscosity of a liquid is the property possessed by that liquid which makes it offer resistance to flow or to relative motion of its layers. It is usually caused by the internal friction between the layers of liquid when there is a relative movement.

According to Duncan (1979), viscosity is a function of molecular size of the molecules of the liquid as well as the bond energy existing between the molecules of that liquid. The longer the molecular chain of a liquid particularly the organic ones, the more viscous the liquid is. Though viscosity results from complicated molecular interaction, its effects on the flow of liquids is usually described by an empirical index called coefficient of viscosity, which in most literatures is simply referred to as viscosity. The knowledge of coefficient of viscosity as well as some other physical quantities such as electro capillarity, thermal conductivity and surface tension of local oils has both domestic and industrial applications. For instance, the coefficient of viscosity of liquid used for industrial purpose can serve as quality index of such liquid. The viscosity of a liquid depends on some variables such as impurities, temperature, electric and magnetic fields.

According to Tabor (1996), Poiseuille in 1942 was the first person to give an accurate method of determination of coefficient of viscosity of liquid when he determined the viscosity of blood in horse's arteries using an equation which is now referred to as Poiseuille's formula. Stokes in 1845 also determined coefficient of viscosity of liquid using ball bearing falling through a viscous liquid contained in a measuring cylinder (Maduemezia & Chike - Obi, 1996). Submission by Duncan (1979) indicated that the coefficient of viscosity of a liquid decreases rapidly with temperature rise. Similar observation was made for water and some oils by Maduemezia and Chike - Obi (1996).

In this study, the variation of coefficients of viscosity with temperature for three local oils, namely, Palm Kernel Oil (PKO), Melon Oil (MO) and Soya Beans Oil (SBO) have been investigated. The PKO was obtained from fruits of oil palm; MO was obtained from melon seeds while SBO was extracted from soya beans seeds.

Experimental Method

Poiseuille's method is most suitable for determination of coefficient of viscosity of liquid obtainable in large quantity and which flows easily, the method was used to determine coefficient of viscosity of water at laboratory temperature (28^{c}) while Ostwald's viscometer was used for the three local oils.

(a) **Poiseuillc's Method:** In this method, water was passed slowly from a constant head apparatus through a capillary tube and the volume collected in a certain time was measured using measuring cylinder. The inner diameter of the capillary tube was measured so as to obtain its inner radius. The constant pressure head as well as (he length of the capillary tube and ihc time of How of water were measured. Then the coefficient of viscosity of the water was obtained from Poisseuille's formula;

$$V = \frac{\prod P r^{4}}{8 \eta L}$$

Where V = Volume rate of flow through the capillary tube. P = Constant pressure r = Inner radius of the capillary tube L = Length of the capillary tube r\ = Coefficient of viscosity of the liquid.

The value of viscosity of water obtained at laboratory temperature (28^{0c}) was in agreement with value quoted by Duncan (1979) and Maduemezia and Chike-Obi (1996). This value of viscosity of water was made use of in the Ostwald's Viscomcter method, which involved comparison of two viscosities.

(b) OstwalcTs Viscometcr Method:- This method is normally used to compare viscosities of two different liquids at the same temperature or the viscosities of the same liquid at different temperatures. If one of the viscosities is known the other can be calculated. This viscometer is a glass instrument consisting of two spherical bulbs with one of the bulbs connected to the other through a capillary tube that joined a U-tube extending from the second bulb. Each of the bulbs opens to the atmosphere through a length of glass tube. In using the viscometer, certain volume of liquid under investigation

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$$\frac{v}{t_1} = \frac{\prod h\rho_1 gr4}{8\eta_2 l} \text{.................} eq.(i)$$

Similarly for the second liquid of viscosity η_2;

$$\frac{v}{t_2} = \frac{\prod h\rho_2 gr4}{8\eta_2 l} \text{.................} eq.(ii)$$

Where "r" and "l" are the radius and length of the capillary tube respectively;

$$\text{From eq. (i); } n_1 = \frac{\prod h\rho_2 gr4t_1}{8vl} \text{.................} eq.(iii)$$

$$\text{And from eq. (ii); } n_2 = \frac{\prod h\rho_2 gr4t_2}{8vl} \text{.................} eq.(iv)$$

$$\text{Hence; } \frac{n_1}{n_2} = \frac{\rho_1 t_1}{\rho_2 t_2} \text{.............................} eq.(v)$$

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$$\text{Hence; } \frac{n_1}{n_2} = \frac{\rho_1 t_1}{\rho_2 t_2} \text{............................} eq.(v)$$

If one of the viscosities is known, by measuring other parameters, the second viscosity can be calculated from eq. (v).

Result and Discussion

The variation of coefficients of viscosity of the three local oils with temperature is shown in Table 1 as well as Figure 1. The curves show that coefficient of viscosity of each oil varies inversely with the temperature; this is in agreement with submission of Duncan (1979), as well as that of Maduemezia and Chike-Obi (1996). It is also obvious from the result that SBO is the most viscous of all the three oils at room temperature and it maintained this higher viscosity above other oils for the range of temperature considered. PKO and MO have closer viscosity at room temperature, but the rate of decrease of viscosity with temperature for PKO is higher than that of MO. However, PKO and SBO responded to change in temperature in a similar way as depicted by their curves, which appear parallel.

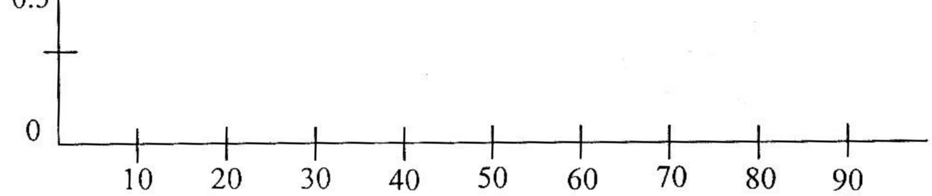
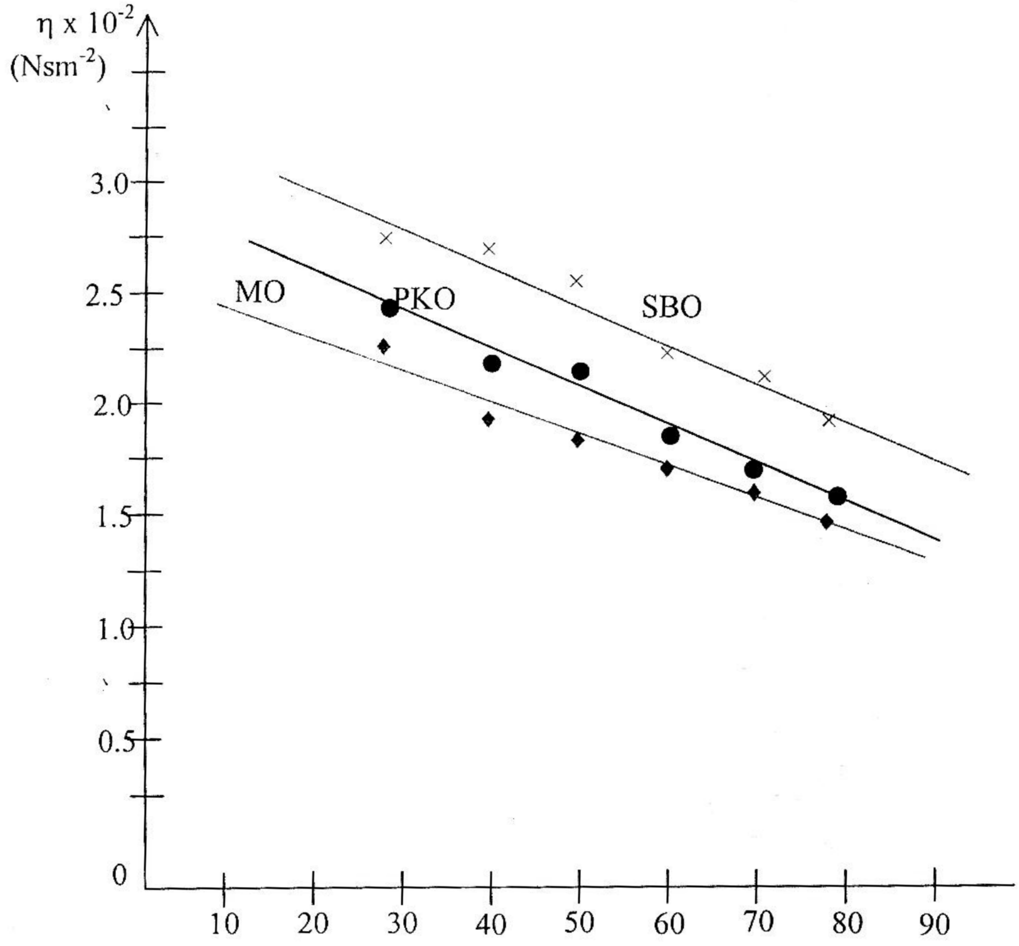


Table 1: Viscosity Of Oils At Different Temperature

Oil Sample	Coefficient of Viscosity x 10^{-2} (NSM^{-2})					
	28^{0C}	40^{0C}	50^{0C}	60^{0C}	70^{0C}	80^{0C}
Palm Kernel Oil (PKO)	2.43	2.23	2.10	1.96	1.83	1.69
Melon Oil (MO)	2.41	2.03	1.95	1.86	1.76	1.65
Soya Beans Oil (SBO)	2.89	2.80	2.63	2.45	2.28	2 .10



Application

Since the experiment showed that coefficients of viscosity of these oils decreased rapidly with temperature rise, the oils cannot be used as lubricant in a situation where large amount of heat may be generated during operation. However, they may be used for lubrication at home and workshops where machine operation cannot produce enough heat that can decompose them since they contain fatty acid.

In the production of margarine where oil is normally hydrogenated so as to increase its viscosity, this may be achieved quickly when naturally viscous oil is used. Thus SBO, which has higher viscosity, will be most suitable for margarine production.

Conclusion

Coefficients of viscosity of some local oils have been found to decrease linearly with rise in temperature. Out of the three local oils investigated, SBO was the most viscous and it maintained its high viscosity above PKO and MO, even as viscosity decreased with rise in temperature. Thus in any application where viscosity is an important factor such as margarine production SBO is the most appropriate.

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