EFFECTS OF TEMPERATURE ON THE OPTICAL PROPERTIES OF CITRULLUS LANATUS (EGUSI MELON) OIL AND ITS POSSIBLE SUBSTITUTE FOR SOME LIQUID CRYSTALS.

[1]Omaghali, N. E. J., [1]James, T. O., [1]Ani, E. B, [2]Yakubu, A. E. and [3]Dawuk, N. D.
[1]Department of Physics University of Jos, Nigeria,
[2]Department of Physics, Kaduna State College of Education, Gidan Waya.
[3]Department of Applied Physics, Federal Polytechnic Nasarawa, Nassarawa.
Correspondence: omaghs@yahoo.com +2348146155497.

ABSTRACT
Spectrophotometric analysis of the effect of temperature on the optical properties of the Egusi (Citrullus lanatus) oil was investigated. The oil was heated from 40^{0}C to 80^{0}C and the UV-Visible absorbance spectra of the Egusi oil show a peak at 300nm over the wavelength range of 200nm to 1100nm. This behavior is in agreement to that of some pure nematic and cholestric liquid crystal, thereby opening up the possible applications of the Egusi (Citrullus lanatus) oil as a possible substitute for nematic and cholestric liquid crystals in certain applications.
Keywords: Temperature, Citrullus lanatus (Egusi) oil, absorbance, Liquid crystals.

INTRODUCTION

Liquid crystals have been found applicable in displays and other electronic devices ((Palto et al,2011; Hogan, et al, 2017) just to mention a few due to their optical properties. Egusi(Citrullus lanatus) oil which contains cholesterols as some liquid crystals has been investigated in this paper as a possible substitute for liquid crystals in certain applications not only for its liquid crystal like properties but also that it offers a cheaper and affordable alternative. Other applications in displays was done by (Govind et al., 2020) where they showed that the photoluminescence intensity increased after the dispersion of quantum dots into pure Cholesteric liquid crystals. The UV absorbance decreased for the QD dispersed CLC system when compared to pure CLC. A research for the essay understanding and analysis of optical phenomena in optical birefringent was investigated by (Dariusz and Jan, 2019). The topic of the study was the calculation of reflectance and transmittance of optical birefringent networks based on cholesteric liquid crystals, showing a selective reflection of the incident radiation and the transmission of the two polarization states. A study (Zaid, 2018) showed a direct proportionality between temperature, absorbance (A), reflectance(R) absorption coefficient and extinction coefficient (K) on the optical properties for (5PCH) liquid crystal. In this paper we have shown that the Citrullus lanatus (Egusi) oil offers similar properties as discussed above and hence a possible substitute for some liquid crystals.

THEORY

In this research, the extinction coefficient K of the Egusi (Citrullus lanatus) oil will be determined. The extinction coefficient, K, is given by (Zaid, 2018):

$$K = \frac{\alpha\lambda}{4\pi} \quad (1)$$

where α is the absorption coefficient and λ is the wavelength . The absorption coefficient α given in by (Zaid, 2018):

$$\alpha = \frac{2303A}{L} \quad (2)$$

where A is the absorbance and L is the length of the cuvvette. Using equation (1), the extinction coefficient for the Citrullus lanatus (Egusi) oil is determined. Also using equation

(2), the absorbance of the Egusi (Citrullus lanatus) oil is determined over the wavelength range of 200nm to 1100nm range.

METHODOLOGY

The Citrullus lanatus (Egusi) seeds were obtained from Faringada market, Jos Plateau State, Nigeria and the oil was extracted using a chemical approach with Hexane as the solvent. The Egusi oil at a room temperature of 25°C was poured in a 3.5ml cuvette which was placed in the spectrophotometer. Thereafter transmittance, reflectance and absorbance measurements were carried out over a wavelength range of 200nm to 1100nm. The oil was the heated to a temperature of 40°C, 50^0C, 60^0C, 70^0C and 80^0C respectively and spectrophotometer measurements for the transmittance, reflectance and absorbance were carried out respectively. The spectrophotometer measurements were carried out over the wavelength range of 200nm to 1100nm.

RESULTS AND DISCUSSION

The graph of transmittance for the Citrullus lanatus (Egusi) oil at various temperatures is shown in Figure 1.

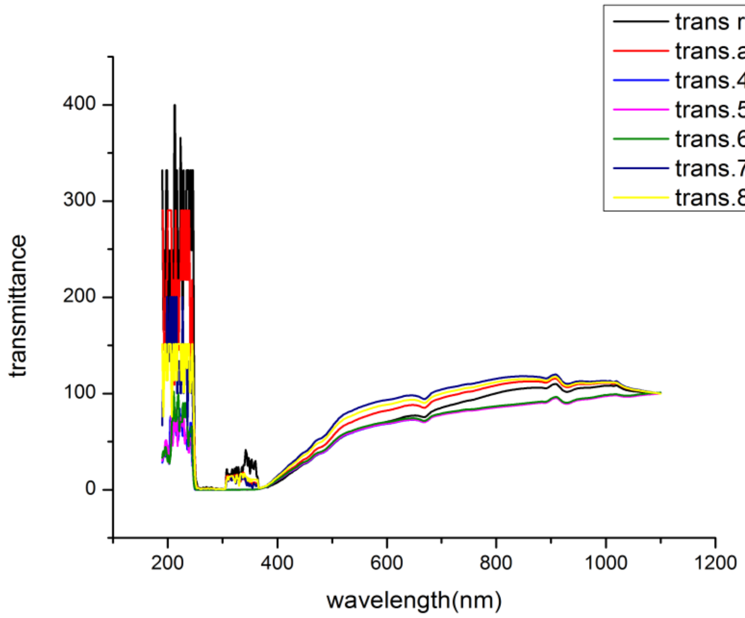

Figure 1: Transmittance with wavelength at temperatures of 40^0C, 50^0C, 60^0C, 70^0C and 80^0C respectively for the Citrullus lanatus (Egusi) oil.

It was observed that the transmittance decreased with increase in temperature from 40^0C, 50^0C, 60^0C, 70^0C and 80^0C respectively over the wavelength range of 200nm to 1100nm.

The absorbance measurements for the Egusi oil is at temperatures of 40^0C, 50^0C, 60^0C, 70^0C and 80^0C respectively is shown in Figure 2. Figure 2 shows the UV-Visible absorbance spectra for the Egusi oil over the wavelength range from 200nm to 1100nm, there is a decrease in absorbance with increasing temperature, which can be attributed to scattering effects in the oil. The reflectance values were obtained and the relation between reflectance and wavelength was plotted in figure 3.

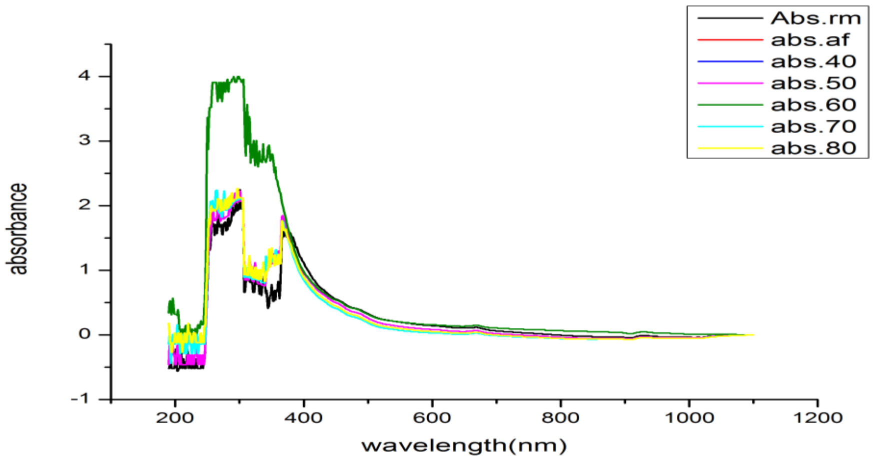

Figure 2: Graph of Absorbance against Wavelength(nm) at temperatures of 40^0C, 50^0C, 60^0C, 70^0C and 80^0C.

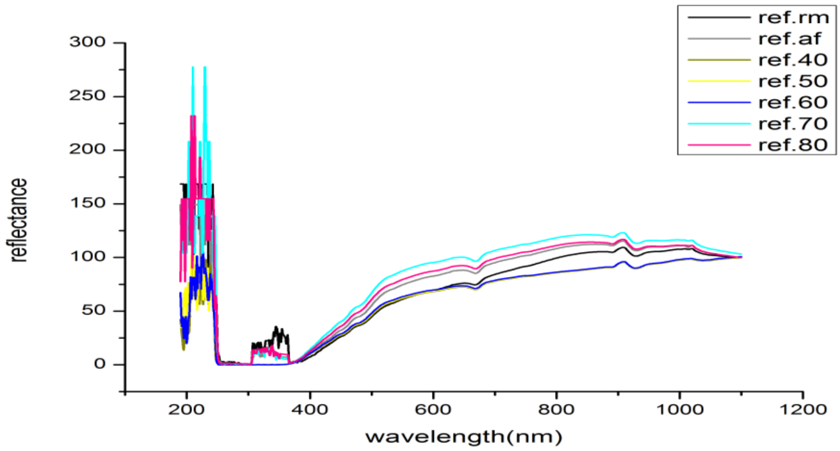

Figure 3: Graph of Reflectance against wavelength(nm) for Egusi oil for temperature of 40^0C, 50^0C, 60^0C, 70^0C and 80^0C.

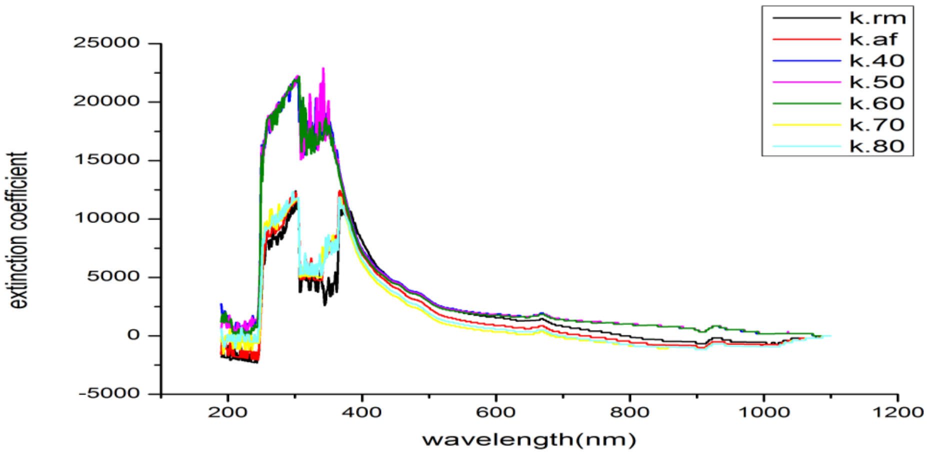

Figure 4: Graph of Extinction Coefficient against Wavelength(nm) for the egusi oil for temperature range 40^0C, 50^0C, 60^0C, 70^0C and 80^0C.

Within the ultraviolet region, reflectance increased with temperature, which can be attributed to the increased random motion of molecules due to increase in temperature. The extinction coefficient for the Citrullus lanatus (Egusi) oil over the temperature range of 40^0C, 50^0C, 60^0C, 70^0C and 80^0C is shown in figure 4. The extinction coefficient was calculated using equation (1). With increasing temperature, the extinction decreased over the wavelength range of 200nm to 1100nm with peaks around 300nm.

CONCLUSION

The effect of temperature on the optical properties of the Egusi (Citrullus lanatus) oil over the temperature range 40^0C to 80^0C was studied. The UV-Visible absorbance spectra of the Egusi oil show an absorbance peak at 300nm over the wavelength range of 200nm to 1100nm. Consequently, this results are in agreement with some pure CLC (Cholestric liquid crystals) (Govind P. et al., 2020) and pure NLC (nematic liquid crystals) (Geeta et al., 2018) which have shown absorbance peaks at 356nm and 305nm respectively in the UV-Visible spectrum. Given the optical behavior of the Egusi (Citrullus lanatus) oil, it therefore opens up its possible application as a substitute for some standard liquid crystals in opto-electronic devices.

REFERENCES

Dariusz, G. and Jan, A. (2019). Calculation of reflectance and transmittance of optical birefringent networks based on Cholestric liquid crystals. *Latin American Journal of Solids and Structures*,1-20.

Govind, P., Gurumurthy, H. and Venna, P. (2020). Octadecylamine-capped CdSe/Zns quantum ot dispersed cholesteric liquid crystal for potential display application: Investigation of photoluminescence and UV absorbance. *Liquid Crystals*, 48:4,579-587.

Geeta, Y., Rohit, K., Govind, P. & Rajiv, P. (2018). Effect of ion trapping behavior of TiO_2 nanoparticles on different parameters of weakly polar nematic liquid crystals. *Journal of Theoretical and Applied Physics*, 12:191-198.

Hogan, B. T., Kovalska, E., Cracium, M. F., & Baldycheva, A. (2017). 2D material liquid crystals for optoelectronics and photonics. *Journal of material Chemistry C*, 5, 11185-11195.

Palto, P. S., Blinov, L. M., Barnik, M. I., Lazarev, V. V., Umanskii, B. A., & Shtykov, N. M. (2011). Photonics of Liquid Crystal Structures: A review, *Crsytallographic reports*, 56,622-649.

Zaid, H. (2018). Influence of the temperature on optical properties for(5PCH) Liquid crystal, *Research journal of pharmacy and topology*. 1-3.