International Journal of Agricultural Technology 2015 Vol. 11(4):811-822
Available online http://www.ijat-aatsea.com
ISSN 2630-0192 (Online)

A Study on the Effect of Washing Kernel on Yield, Colour and A Rheological Property of Snake Gourd Oil

Idowu, D. O.*

Department of Agricultural Engineering, Ladoke Akintola University of Technology, Ogbomoso, Oyo State, Nigeria.

Idowu, D. O. (2015). A study on the effect of washing kernel on yield, colour and a rheological property of snake gourd oil. International Journal of Agricultural Technology 11(4):811-822.

Abstract Viscosity is one of the most important parameters that determine the overall quality, stability and usability of vegetable oil. This study investigated the effect of washing snake gourd kernel before oil extraction on quantity of oil extracted, and colour; and effect of temperature on viscosity of the oil. The oil from the kernel was extracted chemically using Lees-Folch type extraction process. The viscosities of oil extracted from washed and unwashed kernel of snake gourd were experimentally determined as a function of temperature from 40 to 100^o C at 10^{o}C interval using an automatic viscometer (PolyVISC 9724 Z18) and the results obtained were analyzed. The result showed that the oil content from unwashed and washed kernel is 52% and 37% respectively. The colour of the oil was improved by kernel washing. The oil extracted from the unwashed kernel was grayish in colour while the oil from the washed kernel is golden yellow. It was observed that the viscosity of oil from washed kernel were higher at all temperature and varied from 36.49 to 8.84 mm^2/s and that of the oil extracted from unwashed sample varied from 23.38 to 6.48 mm^2/s when the temperature increases from 40 °C to 100 °C. The relationship between the viscosity and temperature of snake gourd oil shows an inverse variation. The result of these experiment are valuable in developing or evaluating system that are involve in the storage, handling, and processing of snake gourd oils.

Keywords: snake gourd oil, oil content, washed kernel, oil colour, oil extraction.

Introduction

The growing demand for oil as food, feeds, biofuel, and in several industries calls for an urgent research into more oil seeds available in our environment. Most of the oilseeds are cultivated primarily for their oil and meals. It has been considered that the need to investigate the vast number of oil seeds is necessary because it is becoming increasingly difficult to meet world demand for edible oil from traditional source. Therefore, there is need for

* **Corresponding author**: Idowu, D. O.; **Email:** idowu.david@yahoo.com

research into other oil seed to forestall the shortage of this important product. FAO (1998) reported that there is a large number of under-utilized indigenous edible plant species that are important to the livelihoods of local population abounds in Africa sub region. One of such high premium indigenous food plant is *Trichosanthes cucumerina* L fruit (Fig.1).

Figure 1. Snake gourd fruit (LAUTECH Agric. Engr. Farm)

Despite the good qualities of the fruit and high quality oil seed (Fig. 2) and its wide consumption by the rural population, the oil from the seed has not been exploited because of lack of adequate information on the oil from the seed.

Figure 2. Snake gourd seeds (LAUTECH Agric. Engr. Farm)

The ability of a particular oil seed to fit into growing industries depends on its utilization potential, rate of production and availability of the processing technology (Idowu and Owolarafe, 2014). Due to the importance of vegetable oils and their effects on the quality and texture of food, the factors affecting their rheological parameters must be considered. The knowledge of a rheological characteristic of vegetable oil is valuable in predicting pumpability and pourability, ease with which it may be handled, processed or used. Viscosity is a principal parameter when any flow of fluid is been considered. It is one of the most important physical properties of fluid system (Fashina and Colley, 2008). The challenges encountered during the design of fluid flow are enormous due to changes in rheological properties of the fluid because of temperature changes. The most important rheological parameter for lubricants is viscosity as it also affects the tribological properties like friction between interacting surfaces and wear. Research has shown that viscosity of vegetable oil is also a very important property in recommending it for biodiesel (Schlosberg *et al*., 2001; Woydt, 2007 Ajay *et al*., 2014). It has been reported that viscosity play an important role in the atomization process, which in turn determines combustion in a diesel engine which consequently influences engine emissions and efficiency (Bernat *et al*., 2012; Blangino *et al*., 2008; Moron-Villarryes *et al*., 2007). Also viscosity is a fundamental rheological parameter that characterizes the food and fluid texture. Oil temperature is one of the most important parameters affecting viscosity because of chemical exchange that happens in heating food during production processes. A lot of work has been published on the effect of temperature on the viscosity of oil (Fashina and Colley, 2008; Santos *et al*., 2005; Steff, 1992). However none has been published on the viscosity of snake gourd oil. Therefore this research is studying the effect of washing snake gourd kernel on oil yield, oil colour and effect of temperature on the viscosity of the extracted oil in order to predict its usability.

Materials and methods

The used snake gourd seeds were obtained from the research farm of the Department of Agricultural Engineering, Ladoke Akintola University of Technology, Ogbomoso, Nigeria. The wet seed of the ripe *Trichosanthes cucmerina* L (Plate 3) was manually removed with hand, washed and sun dried to a low moisture content to enable easy removal of the kernel.

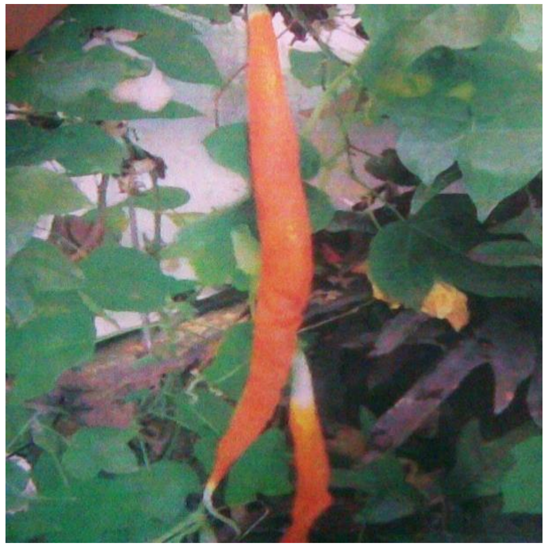


Figure 3. Ripe Snake Gourd Fruit

Shelling had done manually since there was no known decorticator for the seed to our knowledge. The kernels were then divided into two; one sample washed while the other is unwashed. Oil from the two samples was extracted using Lees-Folch type extraction process. To study the effect of the kernel washing and temperature on the viscosity an automatic glass capillary viscometer (PolyVISC) was used to measure the viscosity of the oil extracted from two samples. This viscometer utilized a unique technology to maintain excellent temperature control. This is done by an ultra-stable thermostatic air chamber (the AIRBATH) which controlled temperature within 0.01^{o}C with advanced software because the sample carousel and the viscometer were completely in the AIRBATH. Only the first sample requires a delay for thermal equilibrium changes. The response of viscosity of the two samples to temperature were monitored and recorded. These results of changes in viscosity against temperature were plotted to have rheogram for the two oil samples which was used to explain the effect of the two treatments on the viscosity of the oil. The response of the samples viscosities to temperature were statistically analyzed using Microsoft excel software 2007.

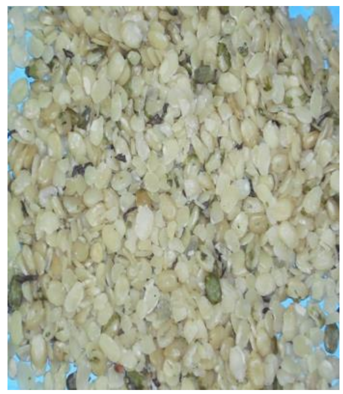
Result and discussion

Washing of the kernel prior to oil extraction showed a great significant difference in the oil properties investigated. The effect of this treatment on the quantity, colour and the viscosity of the oil are discussed below.

Effect of kernel washing on the colour of oil extracted

In food industry, colour has become an important parameter in quality control and in pricing of commodity. Ndom, *et al*. 2011 reported high correlation between colour and consumer decision making and buying behaviour. The results of the effect of kernel washing on the oil extracted from snake gourd shows a high difference in the kernel colour and the colour of the oil extracted (Figs. 4 and 5).

Unwashed



Washed kernel

Figure 4. Washed and unwashed snake gourd kernel

A

B

Figure 5. Oil from unwashed kernel and sample (A), Oil extracted from the washed kernel (B)

The oil extracted from the unwashed kernel was grayish in colour while the oil from the washed kernel is golden yellow (Fig. 5). It showed that the oil from snake gourd kernel is improved in colour by washing. Colour has been reported to dramatically influence the pleasantest and acceptability of foods (Nicolas, 2003; Spence *et al*., 2010; Zampini *et al* 2007). Consumers use colour to determine quality, therefore colour can ultimately affect product acceptance (George, *et al*., 2014; Garber, *et al.*, 2000; Bayarri, *et al.*, 2001). Garber and Hyatt (2000) reported that colour conveys meaning to consumers and sets up flavor and performance expectation to them. It is therefore recommended that all things been equal, if the oil is to use for cooking, washing of the kernel before oil expression is preferred.

Effect of kernel washing on oil quantity extracted

The quantity of oil extracted from the snake gourd kernel was greatly affected by the kernel washing before oil extraction process. Analysis of the results of extraction shows that the oil content extracted from the unwashed kernel is 52 % while the washed kernel is about 37 % . This shows that the colour pigment washed from the kernel also contain some oil. The oil from the unwashed kernel is about the same quantity with groundnut (38-50%) but higher than that of sunflower (25-40%) and cotton (15-25%) as reported by Keller, 2011. The oil extracted is in the range reported in literature for the same seed (Dupriez and De Leener, 1989).

Effect of Kernel Washing on the Viscosity

The viscosity of the two oil extracted were measured with an automatic viscometer polyvisc at different temperatures of 40, 50, 60, 70, 80, 90 and 100 ^{o}C. The oil from the washed kernel has higher viscosity than the oil from the unwashed sample at all temperature (Fig.6).

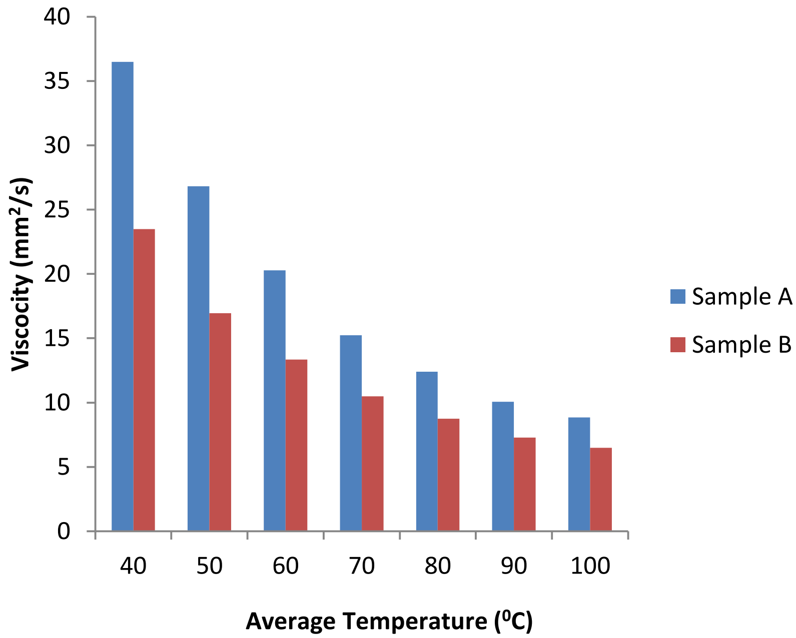


Figure 6. Effect of kernel washing on viscosity of snake gourd oil at different temperature (sample A is oil from washed kernel while sample B is oil from unwashed kernel)

The viscosity of the oil from the unwashed kernel was found to be about 23.38 mm^2/ s, which is closer to the viscosity of 4-D biodiesel oil (Woydt, 2007). It is an accepted fact that viscosity has significant effect on spray characteristics (Aydin and Bayindir, 2010; Utlu and Kocak, 2008; Oguz *et al*., 2007). High viscosity leads to inferior fuel atomization and lower spray speed (Blangino *et al.*2008; Moron-Villarreyes *et al*., 2007 and Bernat *et al*., 2012). For low speed stationary engines, manufacturers recommend an optimum kinetic viscosity of between 13 -17 mm^2/s for fuel before entering the pump. The oil extracted from unwashed kernel has viscosity of 16.65 mm^2/s at 50^o C and 13.65 at 60^oC which is within the range recommended. It was observed that the viscosity of the washed sample was higher than required at low temperature (26.82 at 50^o C and 20.29 at 60^o C), although it is in the acceptable range at higher temperature (15.23mm^2/s at 70^o C). This showed that when considering using the oil for biodiesel, everything been equal, oil from unwashed snake gourd kernel should be considered.

Effect of temperature on the viscosity of snake gourd oil

The results obtained from the experiment show a different temperature response to viscosity for each sample (Fig.7). The oil extracted from the washed kernel gave consistent low viscosities at all temperature compare with oil from unwashed kernel. It was observed for the two oil that the viscosity decrease with increase in temperature. This result is in agreement with the reports in some literatures (Rao, 1999; Fashina and Colley; Santo *et al*., 2005; Lamuel and Tianyins, 2014). The decrease in viscosity as a result of increase in temperature is due to higher thermal movement of the snake gourd oil molecules which in turn reduces the intermolecular forces between the molecules as a result of the flow become easier and reducing viscosity. This low viscosity at higher temperature has been reported by some researcher (Fashina, 2008; Rao, 1999; Steff, 1992; Maskan, 2003). Maskan (2003) reported that a change in viscosity is due to polymerization of oil at higher temperature. The relation between oil temperatures was found to be polynomial. The results showed that the oil from washed kernel is more viscous than the oil extracted from the unwashed kernel. The general mathematical model for the oil from the washed kernel and the unwashed kernel is as shown in Equation 1 and Equation 2 respectively.

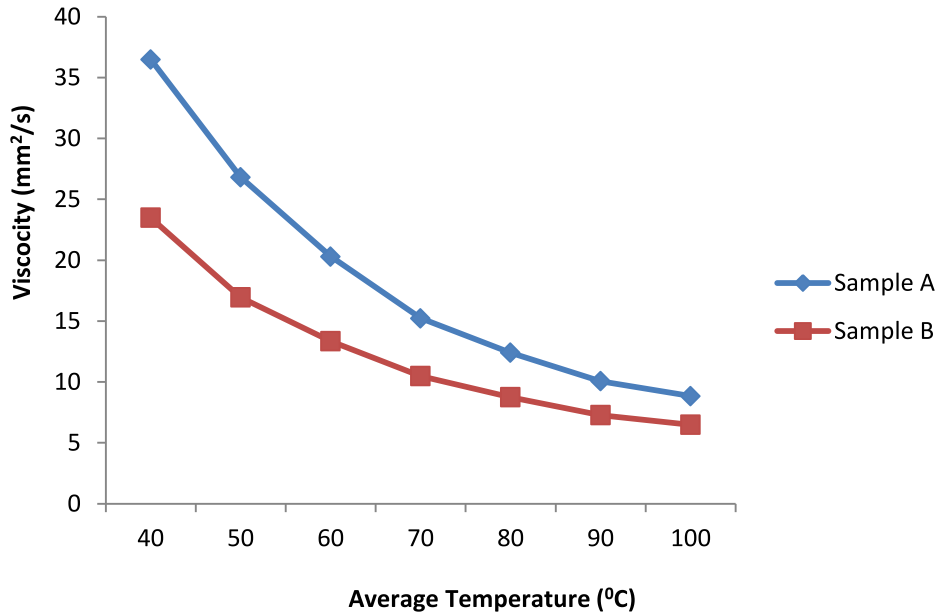


Figure 7. Graph of viscosity against temperature of oil from washed and unwashed snake gourd kernel (sample A is oil from washed kernel while sample B is oil from unwashed kernel)

The model which is exponential decay model is in agreement with results of some researchers on effect of temperature on viscosity of vegetable oils (Azian *et al* (2001); Nasreen, 2013 and Ajay, 2014).

$\mu_w = 26.45e^{-0.21T}$ (R^2 =0.980) (1)

$\mu_u = 43.02e^{-0.24T}$ (R^2 = 0.985) (2)

Where μ_u = viscosity of washed oil
μ_w = viscosity of unwashed oil

T = temperature

The effect of washing on the oil extraction and viscosity of snake gourd oil was significant ($p < 0.05$).

Conclusion

The effect of washing snake gourd kernel on the quantity, colour and viscosity of the oil extracted was found to be significant. The results of the experiment showed that kernel washing reduce the quantity of oil extracted from 52% to 37%. It was also observed that kernel washing improve the colour of the resulting snake gourd oil. The viscosity of the oil from washed kernel was found to be higher at all temperature compare to that of oil from unwashed kernel. It was also observed that as the temperature was increasing the viscosity of the oils was decreasing.

References

Ajay, V., Piyush, K. and Gagan, A. (2014). Study of rheological properties of industrial lubricants. Hindawi Conference Papers in Science.

Aydin, H. and Bayindir, H. (2010). Performance and emission analysis of cotton seed oil methyl ester in a diesel engine. Renewable Energy 35:588-592.

Azian, M. N., Kamal, A. A. M., Panau, F. and Ten, W. K. (2001). Viscosity estimation of their triacylglycerols and of some vegetable oils based on their triacylglycerols composition. Journal of American oil chemist 78:1001-1005.

Bayarri, S., Cavo, C., Costell, E. and Duran, L. (2001). Influence of colour on perception of sweetness and fruit flavor of fruit drinks. Food Science and Technology Internationa l7:399- 404.

Bernat, E., Jordi-Roger, R., Grau, B., Antoni, R. and Rita, P. (2012). Temperature dependent of density and viscosity of vegetable oil. Biomass and Bioenergy (Science direct) 42:164 -171.

Blangino, E., Riveros, A. F. and Romano, S. D. (2008). Numerical expressions for viscosity, surface tension and density of biodiesel analysis and experimental validation. Physical Chemistry 46:527-547.

Dupriez, H. and De Leener, P. (1989). African garden and orchards-growing vegetable and fruits. Belgium : Terres.

FAO (1998). The global plan action on plant genetics resources for food and agriculture. Food and Agricultural Organization, Rom, Italy. 104 pp.

Fashina, O. O. and Colley, Z. (2008). Viscosity and specific heat of vegetable oil as a function of temperature “35 ^{o}C to 180 ^{o}C”. International Journal of food properties 11:738-746.

Garber Jr, L. L., Hyatt, E. M. and Starr Jr, R. G. (2000). The effects of food color on perceived flavor. Journal of Marketing Theory and Practice 8:59-72.

Garber Jr, L. L. and Hyatt, E. M. (2003). Color as a tool for visual persuation. In persuasive imagery: A consumer response perspective. In Scoft, L. M. and Batra, R. (Eds). pp. 313-336.

George, H. V. D., Wuillemin, D. and Spence, C. (2014). Does colour of the mug influence the taste of the coffee?. Flavour 3:1-4.

Idowu, D. O. and Owolarafe, O. K. (2014). Physical properties of snake gourd seed (*Trichosantes cucumerina* L) relevant in grading and separation. Agricultural Engineering International 16:303-312.

Kelle, U. V. (2011). USDA official standard for soybeans. United States No.2 yellow soybeans, 18815 8th Ave. North, Suite 20, Plymouth, MN 55447, USA.

Lamuel, M. D. and Tianyins, L. (2014). Absolute viscosities of vegetable oils at different temperatures and shear rate range of 64.5 to 4835 m/s. journal of Food processing.

Maskan, M. (2003). Change in colour and rheological behavior of sunflower seed oil during frying and after absorbent treatment of used oil, European journal of food research and technology 218:20-25.

Moron-Villarreyes, J. A., Soldi, C., Amorim, A. M., Pizzolatti, M. G., Mendonca, A. P., Doca, M. G. M. (1983). Diesel/biodiesel proportion for by-compression ignition engines. Fuel 86:1977-1982.

Nasreen, D. (2013). The effect of deep heating on rheological behavior of edible vegetable oils. Current Trends in Technology and Science 2:323-326.

Ndom, R. J. E., Elegbeleye, A. O. and Ademoroti, A. O. (2011). The effect of colour on the perception of taste, quality and preference of fruit flavor drinks. Ife Psychologia 19:1-6.

Oguz, H., Ogut, H. and Eryilmaz, T. (2007). Investigation of biodiesel production, quality and performance in Turkey. Energy Source Part A 29:1529-1535.

Rao, M. A. (1999). Rheology of fluid and semi fluid foods, principles and applications. Gaithersbug, USA: Aspen publication.

Santos, J. C. O., Santos, I. M. G. and Souza, A. G. (2005). Effect of heating and cooling on rheological parameters of edible vegetable oils. Journal of food Engineering 67:401-405.

Schlosherg, R. H., Chu, J. W., Knudsen, G. A., Suciu, E. N. and Aldnch, H. S. (2001). High stability esters for synthetic lubricant applications. Lubrication Engineering 57:21-26.

Spence, C., Levitan, C. A., Shankar, M. U. and Zampini, M. M. (2010). Does food color influence taste and flavor perception in humans?. Chemosensory Perception 3:68-84.

Steff, J. F. (1992). Rheological methods in food process Engineering. Mich, USA: Freeman press East Lansing.

Utlu, Z. and Kocak, M. S. (2008). The effect of biodiesel fuel obtained from waste frying oil on direct injection on diesel engine performance and exhaust emissions. Renew Energy 33:1936-1941.

Woydt, M. (2007). Low SAP and alternative engine oil development and testing. Journal of ASTM International 4:6.

Zampini, M., Sanabria, D., Phillips, N. and Spence, C. (2007). The multisensory flavor perception assessing the influence of color cues on flavor discrimination responses. Food qual. Preference 18:975-984.

(Received 3 March 2015; accepted 30 April 2015)