Direct Research Journal of Agriculture and Food Science
Vol. 9, Pp. 297-301, 2021
ISSN 2354-4147
DOI: https://doi.org/10.26765/DRJAFS18581750
Article Number: DRJAFS18581750
Copyright © 2021
Author(s) retain the copyright of this article
https://directresearchpublisher.org/drjafs/

Full-Length Research Paper

Physicochemical analysis of oil extracted from roselle (*Hibiscus sabdariffa L.*) seeds in Kano metropolis

Abdullahi, I. D.[1]*, Zakiyya, M. Y.[2], Yepshak, N.B.[3], Umar, M.[4], Ben-Musa, A. S.[5] and Jibrin, S. J.[1]

[1]Department of Food Science and Technology, Federal College of Agricultural Produce Technology, PMB 3031, Kano, Kano State, Nigeria.
[2]Agricultural Research Council of Nigeria, Abuja Nigeria.
[3]Department of Home and Rural Economics, Plateau State College of Agriculture, Garkawa, Plateau State, Nigeria.
[4]Quality control department, Fortune Oil Mills, Plot 34-42 Tokarawa Industrial Layout, Kano, Kano State, Nigeria.
[5]Department of Computer Science, Federal College of Agricultural Produce Technology, PMB 3031, Kano, Kano State, Nigeria.
*Corresponding author email: abdulibra05@yahoo.com

Received 2 August 2021; Accepted 30 August 2021; Published 6 September 2021

ABSTRACT: Roselle seeds are a byproduct of roselle processing for juices or other related items. The production of oil from roselle seed serves two purposes: economic and environmental. The current study's goal is to look into the potential uses of roselle seed oils. Roselle seeds were harvested and prepared for use by decocting, drying, and crushing. The oil was extracted using a Soxhlet system, and its physicochemical properties were evaluated using standard techniques. The physicochemical characteristics studied yielded the following results. The physical parameters of the oil were evaluated, and the findings were 19.20.452 percent oil content, 1.290.001 refractive index, and 0.890.009 specific gravity, respectively. Also the chemical properties which are peroxide value, free fatty acids, acid value, saponification value, and iodine value were tested the results were recorded 4.33±0.943 meq/kg, 0.19±0.011 %, 0.39±0.023 mgKOH/g, (60.35±0.616 mgKOH/g, 51.16±0.581 g/100g, respectively. Characteristics of roselle seed oil suggest that it could have important applications either as cooking or industrial.

Keywords Roselle seed, oil, soxhlet, physicochemical, analysis

INTRODUCTION

Seeds have nutritive and calorific values which make them necessary in diets. They are also good sources of edible oils and fats (Odoemelam, 2005). In addition, oilseeds were found to be of nutritional, industrial and pharmaceutical importance (Nzikou *et al.,* 2010). The utilization of oil in various applications is largely determined by the yield, composition, physical and chemical properties of the oil (Aluyor *and* Ori-Jesu, 2008). In Nigeria, the major sources of edible oils are peanut (*Arachishypogoea*) and oil palm (*Eloesisguineensis*). These oils are used mainly as cooking oils, for the production of soap, margarine, and cosmetics. However, with the increase in demand, which has led to increase in the importation of cooking oils, there is need to source for local oil-bearing-seeds which can be used in production of oils, both for consumption and industrial applications(Ong *et al.,* 1995).

Roselle (*Hibiscus sabdariffa L.*) is an annual botanical plant belonging to the Malvasia family cultivated in Egypt. There are more than 300 species of hibiscus around the world one of them is roselle *(Hibiscus sabdariffa L*.) which is a member of the plant family malvaceae (Fasoyiro *et al*., 2005; Ismail *et al*., 2008). It is thought of to be native to Asia (India to Malaysia) or Tropical Africa. The plant is widely grown in tropics like Caribbean, Central America, India, Africa, Brazil, Australia, Hawaii, Florida and Philippines as a home garden crop (Gautam, 2004). Two botanical types of Roselle are recognized, *Hibiscus sabdariffa var altissima* and *Hibiscus sabdariffa* var *subdariffa* (Eltayeib and Hamade, 2014). Roselle *(Hibiscus sabdariffa L.)* is known in different countries by various common names, including Roselle, razella, sorrel, red sorrel, Jamaican sorrel, Indian sorrel, Guinea sorrel, sour-sour, and Queensland jelly plant (Mahadevan and Shivali, 2009; Morton, 1987). In English-speaking countries it is known as Roselle, Jamaican sorrel, red sorrel, Indian sorrel, rozelle hemp and natal sorrel. The Japanese name is rohzelu; also sabdriqa or lalambari in Urdu; and lal-ambari, patwa or laalambaar in Hindi (Kays, 2011). In French, Roselle also is the word for the redwinged thrush. In Switzerland, the edible calyx is called Kerkrade. The Roselle fiber is called Indian Roselle hemp, Roselle fiber, Roselle hemp or Pusa hemp. Vernacular names for Roselle include Roselle, jelly okra, lemon bush, and Florida cranberry (Small, 1997). In addition to Roselle, in English-speaking regions it is known as Rozelle, Sorrel, Red sorrel, Jamanica sorrel, Indian sorrel, Guinea sorrel, Sour-sour, Queensland jelly plant, Jelly okra, Lemon bush and Florida cranberry (Mahadevan *and* Shivali, 2009).

In several countries, Roselle is also considered to be one of the most famous folk medicinal plants, where many chemical components present in Roselle have potential health benefits and support the ethno medicinal use of Roselle in promoting cardio-vascular health and preventing hypertension, pyrexia and liver disorders, microorganism growth limitation, as well as a diuretic, digestive and sedative actions. The red varieties of Roselle have antioxidant and cyclooxygenase inhibitory activity. Also, Roselle inters in pharmaceutical and cosmetic industries (Al-Ansary *et al*., 2016). The calyces and leaves of the Roselle are usually used for making jam, jelly, sauces and pickles, the petals of its flowers have been used in Egypt to prepare beverages, which have various important medical purposes (Amin *et al*., 2008).

According to Nyam *et al. (*2009) Roselle seeds contain approximately 15% on a dry weight basis of highly unsaturated triacylglycerols and small amounts of other lipid components. The major unsaturated fatty acids found in Roselle seed oil are oleic and linoleic acid. The presence of high linoleic acid shows that Roselle seed oil could be a good source of essential fatty acids. Furthermore, Roselle seed oil is a rich source of α-tocopherol. The tocopherol is the second major component in Roselle seed oil. Tocopherols are well known as biological antioxidants that can prevent or retard the oxidation of body lipids, which include polyunsaturated fatty acids and lipid components of cells and organelle membranes. High levels of vitamin E detected in the oils, may contribute to greater stability in oxidation (Mohamed *et al.,* 2007). In addition, the seeds also contain phytosterol compounds such as desmethylsterol (Nyam *et al.*, 2009), which is known for its ability to reduce the absorption of dietary cholesterol when included in the human diet (Jones *et al.*, 2000).

There is an increasing need to search for oils from vegetative sources to augment the available ones and also to meet specific applications (Kyari, 2008). Hence, neglected and underutilized plant species readily comes to mind, as exploitation of this will greatly reduce poverty in developing countries. This study presented an opportunity to provide scientific information to validate the extraction of oil from Roselle seed and some of the physicochemical properties of the oil. The information on the health and nutritional benefits of Roselle oil is important for the consumers in general. The gathered and documented information will provide an incentive for commercial utilization of Roselle seed oil in Nigeria. The eventual output is the contribution to the organized body of scientific Knowledge for benefit of other researchers and innovators. The main aim of this study was to extract oil from Roselle seed, to determine the physico-chemical composition of the oil extracted and its applications as alternative source of oil.

MATERIALS AND METHODS

Sample collection and preparation

Sample of Roselle seed was obtained from Kurmi Market in Kano Municipal Local Government, Kano State. The sample was transported in a clean polythene bag and stored in a safe container for analysis. The sample of Roselle seeds was cleaned, sorted, to remove sand, stones, metals, and other foreign matters. The sample was grounded using pestle and motor to fine particle and all necessary precaution were taken to prevent contamination.

Oil extraction

The oil content of Roselle seeds were obtained by complete extraction using the Soxhlet extractor (Konte, USA.) The oil was then stored in a freezer for subsequent use for physicochemical analyses (Warra *et al.,* 2011) (Figure 1).

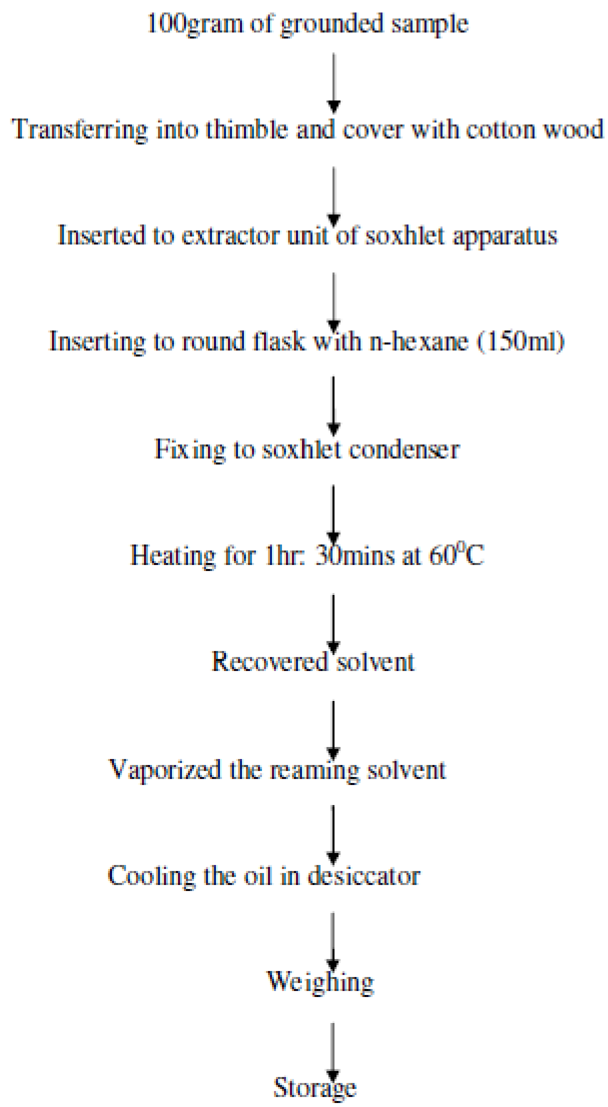

Figure 1: Flow chart of the solvent extraction of oil.

RESULTS AND DISCUSSION

The physical and chemical characteristic of oil extracted from Roselle seed *(habiscussubdsriffsh)* was determined. Oil yield from Roselle seed of 19.20%, was however low to be considered an oilseed for commercial purposes, but their use may not be discouraged, as they are important nutritionally (Kheang and May 2006). The oil yield (19.20±0.452%) in this study was less than that reported for fully matured groundnut (40 to 50%) (Afolabi, 2008). An oil yield of 26 to 42% was considered to be at reasonable yield levels (Kyari, 2008). It should be noted that the mode of extraction is a very important parameter affecting the yield of oil. Such variation in oil content across species and locations might be attributed to the environmental and geological conditions of varied regions (Manzoor et al., 2007). The refractive index which is the ratio of the velocity of light in vacuum to the velocity of light in a medium is an indication of the level of saturation of the oil (Oderinde *et al.,* 2009). The refractive index analysis in (Table 1) showed that Roselle oils had the value of 1.29±0.001, which is lower than the ASTM values that ranges from 1.476 to 1.479 (ASTM International, 2002). This could be attributed to the presence of some impurities and other components of the crude oil mixture. The refractive index values were similar to those obtained by Izuagie *et al. (*2008) for *Cucumeropsisedulis*, *Colocynthiscitrillus* and

Table 1: Physical characteristic of Roselle seed oil.

Characteristic	Result
Oil content (%)	19.2±0.452
Refractive index at 30ºC	1.29±0.001
Specific gravity	0.89±0.009
Colour of the oil	Dark yellow
Physical state at room temperature	Liquid
Odor	Pleasant

The values are mean ±standard deviations for triplicate reading.

Table 2: Chemical parameter of Roselle seed oil.

Parameters	Result
Acid value (mg KOH/g)	0.39 ± 0.023
Free fatty acid (%)	0.19 ± 0.011
Saponification values (mg KOH/g)	69.35 ± 0.616
Iodine values (g/100g)	51.16 ± 0.581
Peroxide value (meq/kg)	4.333 ± 0.943

The values are mean ±standard deviations for triplicate reading.

Prunusamygdalus. The specific gravity of the roselle seed oil was 0.89±0.009 and is closely related to the standard range of 0.898-0.912 approved by Standard Organization of Nigeria (SON, 2000). Specific gravity of oil is an index of its purity. Nuchi et al. (2002) observed that the lower the specific gravity the higher the purity of the oil. The free fatty acid (% FFA) value of Roselle oil was low. The value was 0.19±0.011% which is lower than the stipulated 0.3 maximum by SON. This is an indication that the extent of hydrolytic rancidity in the oil is low. The low free fatty acid value obtained in this study is acceptable based on the initial quality of the oil, and also it is an indicator of the low enzymatic hydrolysis. This low result obtained could be advantageous as the oil with high free fatty acid value develops off flavor during storage.

The acid value of 0.39 mg KOH/g was low. According to Aremu *et al.* (2015), low acid value in oil indicates that the oil will be stable over a long period of time and is protected against rancidity and oxidation. This could be attributed to the presence of natural antioxidants in the seeds such as vitamins C and A as well as other possible phytochemicals like flavanoids. Acid value is used as an indicator for edibility of an oil and suitability for use in the paint and soap industries. High acid value in oil shows that the oil may not be suitable for use in cooking (edibility), but however, can be useful for production of paints, liquid soap and shampoos (Aremu *et al.*, 2006). This can be used to check the level of oxidative deterioration of the oil by enzymatic or chemical oxidation. The acid value is expected to range from 0.00 to 3.00 mg KOH/g in oil before it can find application in cooking.

The Saponification value (SV) of Roselle seed oil was found to be 69.35mg` KOH/g in the sample. The Saponification value was low as shown in (Table 2) and this suggests that the oil can be used in the production of liquid soap, shampoos and lather shaving creams. Alwandawi *et al. (*2015) reported the SV for Roselle red and white’s oil as 189.1 and 189.7mg KOH/g sample. The differences observed might be as a result of the differences in the method of extraction. Saponification values had been reported to be inversely related to the average molecular weight of the fatty acids in the oil fractions.

The iodine value for Roselle seed oil obtained was 51.16±0.581g I/100g. The iodine values obtained from the Roselle seed oil was lower than that of the other common seed oils such as safflower and Soybeans oil with iodine values of 145g I2/100g and 132g I2/100grespectively (cooks *and* Rede, 1996). This value could be used to quantify the amount of double bonds present in the oil, which reflects the susceptibility of oil to oxidation. The iodine value obtained places the oil in the non-drying groups. This oil may find application as a raw material in industries for the manufacture of vegetable oil-based ice cream (Oderinde *et al.,* 2009).

The Peroxide value obtained was 4.33 mEq/Kg. Peroxide value (PV) is the most common indicator of lipid oxidation. High values of PV are indicative of high levels of oxidative rancidity of the oils and also suggest absence or low levels of antioxidant (Aremu, *et al.*, 2015).

The peroxide value (PV) was low. The low value for PV is indicative of low levels of oxidative rancidity of the oils and also suggests strong presence or high levels of antioxidant. Certain antioxidants may however be used to reduce rancidity, such as propyl gallate. The peroxide value was low and is a pointer to the fact that the oils may not be easily susceptible to deterioration. Izuagie *et al*. (2008) observed a PV of 1.72 ± 0.01 and 1.42 ± 0.01 mEq/kg for *C. citrullus* and *C. edulis*, respectively.

Conclusion

The results of this study revealed that the oil extract from Roselle seed is a rich source of oil and has a low acid value, which indicates that it is of good quality. The results also demonstrated that Roselle seed oil has storage stability since it does not undergo oxidative rancidity, and hence the oil can be employed in a variety of culinary applications.

REFERENCES

Afolabi IS (2008). Chemical qualities of oils from some fresh and market vegetable crops within Kwara State of Nigeria. BIOKEMISTRI 20(2):71-75.

Al-Ansary AMF, Nagwa RAH, Ottai MES, ElMergawi RA (2016). Gamma irradiation effect on some morphological and chemical characters of Sudani and Masri Roselle varieties. *Int. J. ChemTech Res*., 9(3): 83-96.

Aluyor EO, Ori-Jesu M (2008). “The use of antioxidants in vegetable oils – A review”, *African J. Biotechnol.,* vol.7, no. 25, pp. 4836-4842.

Al-Wandawi H, Al-Shaikhly K, Abdul-Rahman M (2015). Roselle seed: A new protein source. *J. Agric. Food Chem.,* 32, 510-512.

Amin I, Hainda EKI, Halimatul SMN (2008). Roselle (*Habiscus sabdariffa L.*) seeds – Nutritional composition, protein quality and health benefits, Foods, vol 2(1):1 – 16.

Aremu MO, Ibrahim H, Bamidele TO (2015). Physicochemical Characteristics of the Oils Extracted from some Nigerian Plants Foods. (A Review). *Chemicaland Engineering Research.* 32: 36 - 52.

Aremu MO, Olaofe O, Akintayo ET (2006). Chemical Composition and Physicochemical Characteristics of two Varieties of Bambara Groundnut (*Vignasubterrenea*) flours. *J. Applied Sciences.* 6 (9): 1900 -1903.

ASTM International (2002). Standard test method for oxidation onset temperature of hydrocarbons by differential scanning calorimetry (E2009-02). Annual Book of Standards, section 12.10, ASTM International, West Conshohocken, pp. 734-738.

Cooks LV Van Rede C (1996). “Laboratory Handbook for oil and fat Analysts”, London: Academic Press, 1996, Pp. 30-37.

Eltayeib AA, Hamade H (2014). Phytochemical and chemical composition of water extract of Hibiscus Sabdariffa (red karkade calyces) in North Kordofanstate Sudan. *Int. J. Adv. Res. Chem. Sci*. (IJARCS), 1(6): 10-13.

Fasoyiro SB, Babalola SO, Owosibo T (2005). Chemical Composition and Sensory Quality of Fruit-Flavoured Roselle (Hibiscus sabdariffa) Drinks, *World Journal of Agricultural Sciences* 1 (2): 161-164.

Gautam RD (2004). Sorrel–A lesser-known source of medicinal soft drink and food in India. *Nat. Prod. Radiance,* 3(5):338-342.

Ismail A, Ikram EHK, Nazri HSM (2008). Roselle (Hibiscus subdariffaL.) seeds – nutritional composition, protein quality and health benefits. Food, 2(1): 1-16.

Izuagie A, Akpambang VOE Amoo A (2008). Comparative compositional analysis on two varieties of melon (*Colocynthiscitrullus* and *Cucumeropsisedulis*) and a variety of almond (*Prunusamydalus*). *Res. J. Agric. Biol. Sci*., 4(6): 639-642.

Jones PJ, Raeini-Sarjaz M, Ntanios FY, Vanstone, CA, Feng JY, Parsons WE (2000). Modulation of plasma lipid levels and cholesterol kinetics by phytosterol versus phytostanol esters. *Journal of Lipid Res* 41: 697–705.

Kays SJ (2011). Cultivated vegetables of the world: A multilingual onomasticon. University of Georgia. Wageningen Academic Publishers, the Netherlands, p. 184.

Kheang LS, May CY (2006). Food-grade palm-based industrial lubricants. MOPB Information series. MPOB TT p. 326, 327, and 328. Http:/mpob.gov.my Retrieved on 14/4/2012.

Kyari MZ (2008). Extraction and characterization of seed oils. *Int. Agrophysiscs*, 22: 139-142.

Mahadevan N, Shivali KP (2009). *Hibiscus subdariffa* Linn. - An overview. Nat. Prod. Radiance, 8(1):77-83.

Manzoor M, Anwar F, Izbal T, Bhanger MI (2007). Physico-Chemical Characterization of *Moringaconcanensis,* Seeds and Seed Oil, *J. Amer.Oil Chem.*

Mohamed R, Fernadez J, Pineda M, Aguilar M (2007). Roselle (*Hibiscus sabdariffa*) seed oil is a rich source of γ- tocopherol, *Journal of Food Science,* 72(3): 207–211.

Morton J (1987). Roselle. In: Fruits of warm climates. Julia F. Morton, Miami, FL Pp. 281–286.

Nuchi CD, Hernandez P, Mcclements DJ, Decker EA (2002). Ability of lipid hydroperoxide to partition into surfactant micelles and alter lipid oxidation rate in emulsion, *Journal of Agriculture Food Chemistry,* 50: 5445 – 5449.

Nyam KL, Tan CP, Lai OM, Long K, Man YBC (2009). Physicochemical properties and bioactive compounds of selected seed oils. LWT – *Food Science and Technology* 42: 1396–1403.

Nzikou JM, Matos IL, Loumouamou CB, Ndangui NP, Pambou-Tobi G, Abena AA, Silou TH, Scher J, Desobry S (2010). Proximate Composition and Physicochemical Properties on the Seeds and Oil of *Annonamuricata*have grown In Congo-Brazzaville. *Res. J. Environ. Earth Sci.,* 2(1): 13-18.

Oderinde RA, Ajayi IA, Adewuyi A (2009). Characterization of seed and seeds oil of HuraCrepitans and the kinetics of degradation of the oil during heating. *Electron. J. Environ. Agric. Food Chem.,* 8(3): 201.

Odoemelam SA (2005). “Proximate composition and selected physicochemical properties of the seeds of African Oil Bean (*Pentaclethra marcrophylla*)” *Pakistan Journal of Nutrition*, 4(6):382-383.

Ong ASH, ChooYM, Ooi CK (1995) “Developments in Oils and Fats”, Blackie Academic and Professional, Glasgow, 1995, Pp. 153- 191.

Small E (1997). Culinary herbs. NRC Research Press, Ottawa, Ontario, p. 274

SON (2000). Standard organization of Nigerian. Standard for edible refine palm oil and processed from pp.2-5

Warra AA, Wawata IG, Gunu SY, Aujaka KM (2011). Extraction and physicochemical Analysis of some selected northern Nigeria, industrial oils”, *Archives Appl. Sci. Res,* vol. 3, Pp. 536-541.