International Journal of Scientific Engineering and Applied Science (IJSEAS) – Volume-2, Issue-12, December 2016
ISSN: 2395-3470
www.ijseas.com

The Assessment of Tartar (*Sterculia setigera*) Fruit Seeds as a Promising Sources of Oil and Protein

Safaa A. Hassan[*], Ahlam A. Hussein[**], Manal M. Khattaband[***], Khalid A. Abdelgadir[****]

Abstract:

The aim of this study is to evaluate the nonconventional Tartar Fruit seeds (*Sterculia setigera*) by determining the oil content, protein content and physicochemical properties of oil extracted from whole and dehulled seeds. The composition of whole seed showed 25% oil content and 20% protein. The physicochemical properties of two sample of oil were taken these values: colour (33y/2.4R and 15y/0.5R), viscosity (41.634centipoise and 35.913 centipoise) and refractive index was (1.475 and1.473)for whole and dehulled seed oil respectively. While the free fatty acids of the two samples of oil was 2.8-3.01% as oleic acid. The oil of tartar seed utilized on frying and backing and the protein of seed was utilized on backing, all the products was evaluated by sensory evaluation test.

Keywords: tartar seed; whole seed; dehulled seed

Introduction:

So much attention has recently been focused on the seed oil from different vegetable species especially the forest tree. Thereby scientists of various specialties invest to highlight their new product and its industrial application as cooking oil or for pharmaceutical and cosmetic purposes. In Africa, particularly in savanna area, oil products from native trees are essential for human dietary requirements as well as for use in medicine and cosmetics, but their potentials are far from fully exploited

[*]Safaa Ahmed Hassan, Food Research Center, Khartoum North, Sudan.
Email: safaaahmed31@yahoo.com
[**]Ahlam Ahmed Hussein Food Research Center, Khartoum North, Sudan.
Email:ahlamhussein100@yahoo.com.
[***]Manal Mustafa Khattab Food Research Center ,Khartoum North, Sudan.
Email:Manalkhattab80@yahoo.com
[****]Khalid Abdel Raheem Abdelgadir Food Research Center, Khartoum North, Sudan.
Email: khalidd333@gmail.com

because of lack of information concerning chemical composition of seed oils and their potential uses.

Sterculia setigera (Tartar) is a savanna tree. It is wide spread in the savanna area of tropical Africa; it is a gum species belonging to the family of Malvaceae (Essou ,*et al* .2011). It has been also described under names as *S. tomentosa Guill* and *Perr., S. cinerea A. Rich* (Sacande and Sanon2007).

Scientific classification of *Sterculia setigera*:-

Kingdom: Plantae

Order: Malvales

Family: Malvaceae

Subfamily: Sterculiaceae

Genus: Sterculis

Species: setigera

English name: karaya gum tree; **Local names:** tartar, faider and telieh, posemporgo (Mooré), kongosira (Bambara).

Distribution and habitat:-

The species is widespread in tropical Africa and is common locally the natural distribution range stretches from Senegal to Cameroon in West Africa, Eastwards to Eritrea, and Southwards to Angola. It grows in Savannah type vegetation on a variety of soil types, thriving on poor soils as well as on hilly/stony sites. It is deciduous tree often found on hills, rocky, poor, and little deep soils township of northern and north-guinea savannas. The leaves are simple and have 3 to 5 triangular lobes, densely pubescent. Flowerings appear during the second half of the dry season between February and April in the northern zone, at the same time as news leaves and the maturation of fruits in December. The fruits are composed of 4 or 5 boat- shaped carpel's which split to reveal about 12 slate- colored seeds, 10-15 mm long (Keay, 1989).

Tartar is a multifunctional forest woody tree species in sub-Saharan Africa, especially known in Senegal for its economic value; its gum is exported since several decades. It is found in abundance in the West African region and some East African countries like Sudan.

In Sudan tartar is the forest trees plants grown wildly in Darfur, Kurdofan and south the Blue Nile areas, those trees were found to be as a miner source of edible oil, beside the other major oil seeds. The seeds or the fruits of Tarter can be exploited as a source of oils and protein. There is little information on the nutritional and chemical compositions of *Sterculia setigera* seed. Idu. *et al*., (2008) studied the nutritional evaluation of *Sterculia setigera* seeds and pod and found that the crude protein was found to be 21.40% in the seed sample and 4.36% in the pod
Sample,the result, though higher than earlier report on the same species (Ighodalo *et al*, 1993) is comparable to 22.86,23 and 29% reported on seeds of *Teramnus labialis* shelled rubber and vigna unguiculata sp. the seed of *Sterculia setigera* has a considerable promise as protein source.

El Khalifa, (2007) studied Tarta tree in Sudan which spreads naturally in central and Southern Sudan, the species is the main source of the internationally accepted gum karaya in Sudan, seeds of Tarta contain 25.65%. fibre, 3.45%ash, 11.12% carbohydrates, 24.10% protein and 25.25% oil.

Bazongo, *et al*, (2014) reported that; the most dominant fatty acids in tartar oil were palmitic acid (25.8%), sterculic acid (20.0%) and linoleic acid (19.8%). Linoleic acid (30%), oleic acid (21%) and palmitic (20%) acid have been reported as the dominant fatty acid of the species of Senegal (Miralles, *et al*., 1993). Both cyclopropenic acids (sterculic acid (20.0%) and malvalic (11.6%) have been found in higher content that of 17.1% reported for the specie of Senegal.

In Sudan, rural and tribal people collect the fruits from nearby areas and use them as food. The fruit trees are known as supplement and improve quality of diet and have multipurpose uses other than food.

The Tatar trees produced large amount of seeds, only small amount utilized by animals and humans as a source of oil and protein, while most of it were lost. Harvesting enables rural people to provide a balance diet and generate income

This work has been designed for encouragement of a regular cultivation, production and utilization of the wild produce (Tartar), which attribute in enhancement of the potential economics level of the farmers families The specific objectives are to develop new products out the mentioned wild fruits, beside studying them quantitatively and qualitatively through estimation of oil, protein, and effect of the physio-chemical properties of the developed product.

Materials and Methods:

Materials:

The seed of *Sterculia setigera* (Tartar) were collected from the Blue Nile area (Domain Damazin forest). The samples were dried and stored in plastic bags at a room temperature until use.

Methods:

The seeds were divided into two groups (a) whole seeds and (b) dehulled seeds. The whole seeds were subjected to determine the crude protein and crude fat according to (AOAC, 2005).

Fat content determination:

Crude fat was determined according to the AOAC, (2005) method. 2g weights of samples were extracted with hexane for 8 hours using Soxhlet apparatus. The solvent was evaporated and the remaining crude fat was determined.

$$\text{Fat \%} = \frac{W2 - W1}{\text{Weight of sample}} \times 100$$

Where:

W1 = Weight of empty flask.

W2 = Weight of flask with oil

Protein content determination

The protein content of the samples was determined by the micro-kjeldahl method (AOAC, 2005). A 0.2 g of defatted sample was weighed accurately into a micro-Kjedahl flask, 0.4g of catalyst mixture and 3.5 ml of concentrated sulphuric

acid were added, the flask was then placed into the Kjedahl digestion unit for about 2 hours until a colorless digest solution was obtained. The flask was left to cool to room temperature. 20 ml of 40% sodium hydroxide solution were added to the digested solution and the mixture was heated. The ammonia evolved was trapped into10 mls of 2% boric acid solution, then titrated against 0.02N hydrochloric acid using universal indicator (methyl red + bromo cresol green. The total nitrogen and protein were calculated using the following formula:

$$\text{Nitrogen [\%]} = \frac{\text{Volume of Hcl} \times N \times 14 \times 100}{\text{Weight of sample} \times 1000}$$

Protein [%] = Nitrogen [%] × 6.25

Where:

Nitrogen [%] = crude nitrogen.

Protein [%] = crude Protein.

N = normality of Hcl.

14 = equivalent weight of nitrogen.

Oil Extraction: After cleaning and removal of the sand and foreign materials, the dried Tartar seeds of two sample (a) and (b)were ground to semi fine powder using a mortar. The oil of two sample (a) and (b) was extracted with n-hexane (1:4 w/v) by agitation in a shaker at room temperature for 36 h. The solvent was evaporated to dryness. The extracted oils were stored in bottles until analysis.

Tartar Oil characteristics

1-Refractive Index

The refractive index (RI) was determined by an Abbe60 refractometer according to the AOAC method (2005) at30°C.

2-Viscosity

The oil viscosity was determined using an Ostwald-U-tube viscometer according to AOAC method (2005).

3-Color

The color intensity of oils was recorded using a Lovibond Tintometer as units of red, yellow, and blue according to the AOCS method (1993).

4-Free Fatty Acids

The method used for determination of free fatty acids (FFA) was that of Cocks and Van Rede (1966). 10gm of oil were dissolved in a 50 ml of solvent (ethanol/ diethyl ether) then titrated while swirling with 0.1N NaOH solution using phenolphthalein as indicator, FFA was calculated as follows:

$$FFA = \frac{V \times N \times XM}{10XW}$$

Where:

V: Volume (in ml) of NaOH used.

N: Normality of NaOH.

M: Molecular weight of fatty acid (28.2 as oleic acid).

W: Weight (in gm) of sample.

The oil utilization:

Frying:

The oils (a) and (b) were used for frying chips A and B, the products were sensory evaluated compared with other product fried by ground nut oil (C).

Backing:

The oils (a) and (b) were used for production of biscuit (A1) and (B1) the products were sensory evaluated.

The protein utilization:

Backing:

The protein (cake) was used for backing biscuit instead of eggs and added to the bread to improve the quality. The products were sensory evaluated.

Sensory evaluation:

The chips (A and B) and biscuits (A1 and B1) which processed by the tarter oil A and B were sensory evaluated by the ranking procedure described by Ihekoronye and Ngoddy (1985). Semi-trained staffs (15 panelists) from the Food Research Centre (FRC), Shambat, were asked to examine and evaluate the biscuits and the products subjected to the ranking test, according to colour, texture, flavour, and preference. Ranking was done for the four samples:

(1= excellent, 2= very good, 3 = good and 4 = unacceptable) for the different attributes. Sum of ranks were then statistically interpreted according to a table given by Ihekoronye and Ngoddy, (1985).

The best product was compared with biscuit collected from the market by panelists for second time.

The above experiment was repeated for the products processed by Tartar protein biscuit and bread.

Result and Discussion:

Composition of Tartar Seed

According to the results in (Table 1) the oil content of whole seeds of Tartar oil was (25%) which was equal to that found by Mariam ,(1999) and less than that reported by Patrice Bazongo *et al*., (2014) which were (30.7%). The crude protein was found to be 20% in the seed, the result was higher than that reported by Abdel Raheam, *et al*. (2015) and equal to that reported by Lawa *et al*.,(2010).The composition of Tarter seeds were matched with Cotton Seeds Salunkhe, (1995).

Table 1.Show the Composition of the whole seed

Parameter	Content
Oil Content (%)	25
Protein (%)	20

Physicochemical properties of Tartar seed oil:

The results of physiochemical studies showed in(table 2) of the oil extracted from the whole seeds(a) and de-hulled seeds (b) had a different values in color ; sample (a)had 33y-2.4R which was high values in Yellow and Red color than sample(b) 15Y-.5R ,the viscosity of sample (b) was lower than sample(a),these results approved that sample(b) was better than sample (a) and this contribute to that oil extracted from the whole seeds should be refined.

Table2. Show the physicochemical properties of the two oil Samples

Parameter	Oil extracted of Whole seeds(a)	Oil extracted of dehull seeds(b)
Colour	33y/2.4R	15Y/ 0.5R
Viscosity (moms)	41.634	35.913
Refractive index	1.475	1.473
Free fatty acids (%)	2.8	3.01
Peroxide (meq active oxygen/kg.oil)	6.2	8.6

Sensory Evaluation Result

Acceptability of Chips (A and B) processed with Tartar oils (a and b) The data in (Table 3) concerned with chips processing, shows significant difference ($P \leq 0.05$) in colour, texture, flavour and preference between the products A. B and C. The chips B was the best product followed by C and lastly A.

Table 3.Acceptability test of Chips (A and B) processed with Tartar oils (a and b) compared with Chips(C) fried by groundnut oil.

Product	Sum of rank			
	Colour	Texture	Flavour	Acceptability
(A)	28^{b}	19^{a}	30^{b}	21^{a}
(B)	15^{a}	16^{a}	28^{b}	22^{a}
(C)	25^{b}	19^{a}	35^{c}	28^{b}

Acceptability of biscuits processed by Tartar oil (a and b)

Table (4) shows the results of the biscuits processed with Tartar whole seeds oil (A1) and de-hulled seeds oil (B1). Sample (B1) indicates significant difference ($P \leq 0.05$) in colour, texture, flavour and preference than (A1) products .The product (B1) is found to be better than product (A1), and in comparing the (B1) biscuit samples with another samples brought from the market (C1) as presented in table (5), it was found the market sample to be better than the product B in colour and preference and equal in texture and flavour.

Table 4.Acceptability test of biscuits processed by Tartar oil (a and b)

	Sum of rank

Product	Colour	Texture	Flavour	Acceptability
(A1)	28[b]	19[a]	30 [b]	21[a]
(B1)	15 [a]	26 [b]	28 [b]	22 [a]

Table 5.Accetability test of biscuit (B1) processed by Tartar oil (b) compared with sample(C) from market

Product	Sum of rank			
	Colour	Texture	Flavour	Acceptability
(B1)	28[b]	19[a]	30 [b]	21[b]
(C1)	15 [a]	26 [b]	28 [b]	15 [a]

Conclusion:

Sudan is rich in wild indigenous fruits .these is used traditionally as food additives, in traditional medicine, supplement of diet and in the preparation cosmetics. The multipurpose seeds will encourage their exploitation and raise their economical values. More work is needed for the experiment of bread processing and protein utilization.

References:

1. **A.O.C.S., (1973).** American Oil Chemists Socity Official and Tentative Method of merican Oil Chemists. Socity. 2nd Aosc- Champaign IIIinois

2. **Abdel Raheam H. A., Omnia M. M.and Nafisa I. H. ,(2015).**Sterculia setigera seeds as food for Tilapia Fish (Oreochromis niloticus) Finger lings .J. of EUROPEAN ACADEMIC RESEARCH - Vol. III, (2).
3. **AOAC, (2005).** Association of Official Analytical Chemist, Arlington, Virginia, USA.
4. **Bazongo, P.; Bassole, I.H.N.; Nielsen, S.; Dicko, M.H.and Shukla, V.K.S., (2014)**. Studies in the Evaluation of Unconventional Oils from Burkina Faso Rich in Linoleic Acid, Oleic Acid or Other Unusual Fatty Acids. J Food Process Technol 5: 303.
5. **Cock,L.V. and Van Rede,C.,(1966).** Laboratory Handbook for Oil and Fat Analysis. Academic Press,London and New York.
6. **El Khalifa, A.A., (2007).** Domestication of *Sterclia setigera* (L)in Sudan. Ph.D. Thesis, University of Khartoum
7. **Essou, J. P.; Adjakidje, V. and Akouegninou, A., (2011).** Les nouveaux. et d' Ecologie Vegetale, 1ere edition.ordres des angiospermes (Utilites des especes), Fascicules a l'usage des etudiants de Licence et de Master en Sciences naturelleset Agronomie, Abomey-Calavi: Laboratoire de Botanique et d' Ecologie Vegetale, 1ere edition.
8. **Idu,M., S; Uzoekwe and. Onyibe H.I, (2008).** Nutritional evaluation of Sterculia setigera seeds and pod. Pakistan J. of Biological Sciences 11(1):139-141.
9. **Ighodalo, C.; Eromosele, C. and Eromesele, O., (1993).** Studies on the chemical composition and physio-chemical propertiesof seeds of some wild plants.Plant foods Hum. Nutr.43:251-258.
10. **Ihekoronye, A.I. and Ngoddy, P.O.,(1985).** Integrated food Sciences and technology for the tropics. Edu Macmillan and Publisher.
11. **Keay, R.W.J., (1989).** Trees of Nigeria. Oxford University Press, New York, pp: 476.
12. **Lawal, I.O.;Uzokwe N.E and.Igboanugoetal. A.B.I, (2010).**"Ethno medicinal information on collation and identification of some medicinal plants in Research Institutes of South-west Nigeria,"African Journal of Pharmacy and Pharmacology, vol. 4, no. 1, pp. 001–007

13. **Mariam, Y.E. (1999).** Potentially Industrial Utilization of Tarter (Sterculia setigera) oilseed M.sc. Thesis.
14. **Miralles, J.; Bassene, E.; Gaydou, E., (1993).** Determination of cyclopropenoid fatty acids in Sterculia seed oils from senegal. J Am Oil Chem Soc 70: 205-206**.**
15. **Sacande, M. and. Sanon, M., (2007).** Sterculia setigera Delile, Seed Leaflet no. 134, Forest & Landscape Denmark, Horsholm, Denmark.
16. **Salunkhe,D.K., (1995).** Cotton seed .World Oilseeds, Chemistry, Technology, Text Book p, 249.