EXTRACTION AND CHARACTERIZATION OF GUNA OIL

MAINA, C. Y.
ALIYU, H. M.

ABSTRACT

This study carried out on guna was to determine the extraction and characterization of guna oil. The results showed that the fruit (pod) has about 70% pulp, 10% seed and 20% epicarp with a density of about 881 .25kg m^{-3}. The chemical analysis of the seed showed that the seed has about 3.8% moisture, 2.18% ash, 2.6% crude fibre (defaulted seed), 27.2% crude protein, 46.88 oil and 17.4% carbohydrate. Comparatively this showed that guna oil seed has more oil than most vegetable oil seeds. The analysis of the oils showed that it has a saponification number of 185, iodine 104, with thermal stability of boiling point, smoke point and solidification point of 115°C, 185°C, and 2.5°C respectively and a viscosity of 42.5, 43.75, 53.00 and 72.5 for the respective shear rates (r.p.m) at 10, 20, 50 and 100. Based on the result, it was concluded that guna oil is more valuable than most oil seeds, and can favourably substitute other oils.

Key Words: *Guna, Characterization, Oil.*

INTRODUCTION

Guna is the local name given to the plant cucumbita species as well as the seed of the plant. Its botanical name is *Cucurbita citrullus* species which is commonly known as "cow-melon" or "Desert melon". It is thought to be of tropical origin and Nigeria inclusive. It is commonly found in the wild arid and swampy (Fadama) areas. It is cultivated in the northern areas of Borno, Yobe, Kano and Jigawa States. It is grown for its relatively high oil content principally as a cash crop.

Guna plants are drought resistant annual creepers that spreads their weak trailing stem covering an area of about four square meter (4m^2) and having a very pronounced taproot system. Their pods are at first green and hairy but when ripen it becomes grayish to white in colour, shiny and smooth. The fruits pods are round but can also be lobe in few cases and variable in size. The seeds are flat, smooth and yellow to slight white in colour and very numerous. On the average, they are of medium size which are embedded

Maina, C. Y. *and* ***Aliyu, H. M.*** *are Lecturers in the Department of Animal Production, Food Science and Nutrition, Federal University of Technology, Minna, Niger State, Nigeria.*

in the soft pulp tissue of the fruit. The Guna plant is well known and cultivated in the Northern area of Borno, Yobe, Kano and Jigawa States where the guna is cultivated as one of their cash crop. Guna can tolerate harsh adverse climates and environmental conditions than other plants. It grows in a wide range of places from Desert where rainfall is very scanty to swampy (Fadama) area and in rocky places (such as a Biu area). It can therefore be correctly asserted that it has no defined maximum or minimum rainfall requirement. It is believed that a cup of water is enough for the plant to grow (personal verbal interview).

Among the areas of wide guna production Gashua and Nguru area have fine loose desert soil (loamy) that seems to be most common soil on which the crop is cultivated. The guna producing areas under study known of generally two varieties: (i) where the pod are relatively smaller and striated, the seeds are black with thick hard pericarp, and relatively rough, is called the wild variety and are not cultivated. The farmers believe has low oil yield, (ii) the unstriated pods, with smooth yellowish seeds are the variety cultivated - hence called the home variety and known to have higher yield of oil. The guna seeds are sown directly on the farm. There was no report or evidence of propagation by transplantation; the spacing is usually about 1.5m by 1.5m and sown in holes of 3-4 cm deep. This crop is sometimes and at some places sown together with millet but the guna never grown (probably due to too much water) until after the rain when the millet is harvested and in the months of September to April when there is very little moisture remaining in the soil. Cropping could be done twice depending on how early the sowing was done. All that the seed requires, is little moisture that will enable it germinates. In the so called flood-plain (Fadama) area its cultivation is only viable when the water is drained.

Guna seed is believed to have a very high oil content and being a legume, it is as well expected to have appreciable protein content. Organoleptically, the quality of oil from guna is similar to that obtained from groundnut, depending on the processing method. Some few cases of individuals experienced the bitter taste. The objectives of this study are to survey areas of cultivation, investigate local processing and used of guna, carryout physical and chemical analysis of oil seed and oil characterization.

MATERIALS AND METHODS

All samples lavina pod (fruits) and seeds were obtained from Garin - Alkali Bade local government, Yobe State. The oil (guna oil) was expressed in the laboratory except the groundnut oil which was bought from old G.R.A Maiduguri. All chemicals used are from the Department of Food Science and Technology Laboratory, University of Maiduguri and are of analytical grade except where stated. Seeds for oil extraction are dehulled, washed thoroughly and dried. This is said to reduce and or remove the

bitter factor of the seed. Locally, the extraction of oil from the seed involves mild roasting of the seeds (this process is believed to give maximum extractable oil, chemically, mechanically as well as manually), then grinding the seeds into paste or powder and the oil is extracted as: the milled guna is mixed with some quantity of water in pot and kept boiling with occasional stirring. The oil which floats on top is decanted and more water added, while the boiling and stirring continues and the whole procedure repeated until such a time when there is practically no decantable floating oil on the boiling water.

As with the processing of groundnut oil expression, the milled guna is mixed with some quantity of warm water in a bowl and the mixture is kneaded strenuously until the oil separate out and gradually collected into a container and until the expressible oil is expressed by the method. The cake resulting from this method is fried. The refractive index was determined by dropping a file on the objective lens of a refractometer and adjustments made to read its value of 29°C. the same was done for ground nut oil used for comparison. The density of guna oil was determined using the method described by Nelkon and Parker (1982).

The method used in the determination of Specific Gravity (Relative density) was adopted from Nelkon and Parker (1982). In the determination of Boiling point, the guna pot (20ml) was placed in beaker (50ml) and a thermometer inserted with its sensitive bulb end just above the bottom of the beaker and it was heated. The temperature at which the oil starts to boil (by giving some bubbles) was recorded as the boiling point of the oil. The determination of smoke point also based on the method described by Nelkon and Parker (1982). To determine Solidification point, some quantity of the oil was put into a test tube (7x5ml) about one quarter (1/4) full and a thermometer inserted, just touching the side of the test tube. The tube and thermometer was placed in a deep-freezer and allowed to freeze. The test tube was removed and the temperature at which the freezed oil starts to melt was read and used as the solidification point of the oil. Brookfield viscometer was used in the determination of Viscosity. One spindle was attached to the lower shaft of the Brookfield synchro-dective viscometer. The spindle was inserted into the test oil until the oil level was at the immersion groove, cut in the spindle shaft and the viscometer was leveled. The clutch was then depressed and the viscometer motor turned on. The clutch was released and the dial was allowed to rotate until the Pinter stabilized at a fixed position on the dial. The readings were recorded at different shear rates of 10, 20, 50 and 100 r.p.m.

The viscosity of the oil was obtained by consulting the factor finder (sliding scale) supplied with the viscometer. In Moisture content determination, the method used was based on the AOAC method, (1984). The determination of Ash and Lipid contents was based on the method described by Pearson (1976). Crude Protein Determination was determined by Macro-Kjeldahl method following the procedure spelt out by Pearson (1976). The crude fibre determination method was carried out, following the

procedure described by Pearson (1976), using the Acid-based method. Since there is no single simple adequate method for the determination of total carbohydrate it was determined by thus: %carbohydrate = 100% (moisture + protein fibre + ash + lipid). The method used to determine Saponification and Iodine values was based on that of AOAC(1984).

RESULTS AND DISCUSSION

Dimension of Pod: The maximum diameter of the guna pod was found to be about 15.72cm with a weight of 1.83kg and minimum diameter of about 10.85cm, weighing about 0.12kg. Thus, guna has a mean diameter of 12.87 cm with a mean weight of about 0.987kg. The pod has a mean volume of 0.0012m3 91.12 x 10-3 m3) with a specific gravity (relative density) of about 881.25kgm-^{3}.

Composition of Fruits (pods): The analysis conducted on the constituent component of the pod show that pod is 70.66% (mainly made of pectic substance) into which the seed constituting 10.3% are held within the pericarp is 19.56%. This pericarp (epicarp) is very hard probably made of cellulose and lignin materials

Table 1: Constitution of pod

	Cultivated Varieties	Wild Varieties
Constituent	Mean (%)	Mean (%)
Pulp	70.12	70.66
Epicarp	19.56	19.8
Seed	10.30	9.53

Mean seed weight and dimension (dry seed): The mean dry seed weight was found to be about 0.35 g, having a length of 0.82mm, breadth of 0.51mm and width (thickness) 0.22mm (table 2)

Table 2: Seed Dimension

Dimension Mean (mm)	Cultivated Variety Mean (mm)	Wild Variety
Length	0.85	0.82
Breadth	0.53	0.51
Width (thickness)	0.22	0.23

Seed Composition: The bran (husk) and the endosperm (hulled seed) was found to be 26.95% and 73.04% respectively for the cultivated variety, while the wild variety has a lesser percentage of endosperm of about 58.1% as against the bran which has 41.9% (table 3). Thus, for higher yield (both oil and cake), the cultivated variety has a better advantage (endosperm advantage).

Table 3: Constitution of Seed

Constituent	Cultivated Variety (Mean)	Wild Variety (Mean)
Seed	73.04%	41.9%
Bran	26.96%	58.1%

Specific Gravity: The specific gravity was found to range from 0.913 -0.918 (table 4). This is one of the measures of purity. Thus, when the oil is adulterated with other oils, this value is expected to change. The value is very similar to those of other vegetable oils (Egan et al. 1981). Specific gravity is temperature dependent. Thus the value gotten was determined at 35°C.

Table 4: Physico-chemical content of Guna Oil

Refractive Index	1.470
Iodine Number (value)	104.87 ± 3.9
Saponification number (value)	185
Specific Gravity	0.913 - 0.918
Boiling Point	115 ± 5°C
Solidification Point	2.5°C
Smoke Point	185°C

Thermal Stability: The thermal stability in respect of the smoke point, boiling point was found to be low, further confirming the fact that the oil is made up of high level of lower molecular weight fatty acids, thus, liquid at ambient temperature. The boiling and smoke point of guna oil was found to be about 115°C and 15°C while that of groundnut was 135 C and 227°C as reported by Hil 1992). This low thermal stability implies that the oil is expected to have less ability in withstanding high temperature operations like deep fat frying and so on.

Refractive Index: The refractive index was found to be 1.470 at 29°C which is similar to that of groundnut gotten as 1.460. The later is similar to that reported by Egab et al., (1981). This means that the oils (guna and groundnut oils) have similar clarity.

Viscosity: The viscosity of the oil was found to be 42.5, 43.75, 53 and 72.5 comparing well with that of groundnut which was 42,43.5 52.75 and 71. 75 for the respective share rates of 10,20,50 and 100 rpm at 35°C (table 5). The viscosity is a measure of the force of attraction existing between the molecules of the oil which opposes the motion (movement) of a body (particle) within the oil. This value is temperature dependent and is very useful in technical applications like pumping the oil through pipes at relative temperatures as well as in determination of surface tension and renould number (Re).

Table 5: Comparison of Viscosity of Guna and Groundnut Oils

Shear Rate (r.p.m)	10	20	50	100
Viscosity (c.p.) Guna	42.5	43.75	53	72.5
Viscosity (c.p.) Groundnut	42.00	43.5	52.75	71.5

r.p.m = revolution per minute
c.p = centipoises

Iodine Value: The iodine number was found to be from 100.97 -108 .77. Thus within the range of iodine number for vegetable oils as reported by Egan et a]., ((table VI). The iodine number is an indication of the degree of unsaturation of an c is due to single, double or triple bonds existing in the fatty acids carbon sl constituting the glyceride which generally make up the oil. Therefore a high iodine indicate a corresponding high degree of unsaturation of the fatty acid constituen oil. Higher iodine number is used as an index of knowing the suitability of a lipi formulation of paints and other industrial applications (Hui, 1992).

Table 6: Comparison of the Physico-Chemical Properties of Guna oil with O other oil Seeds.

Oil seed	Sp.Gr	Ref	SapnValue Index	Iodine	B.P. (°C) Value	S.P.	So.P (°
g/nut	.914-.917	1.46-1.465	187 196	80-106	135	227	
Cotton seed	.198-.926	1.458-1.466	189-198	99-119	-	-	
Rapseed	.910-.920	1.465-1.469	168 181	94-120	-	-	
Sunflower	.918-.923	1.467-1.469	188-194	110-143	-	-	
Guna seed	.913-.917	1.470	185	102-108	115±5	185	2

B.P - Boiling Point
So.P - Solidfieation Point
S.P - Smoke Point

Saponification Value: This was found to be about 185 which is within th 168 -196 for vegetable oils as reported by Egan et al., (1981). This measures molecular weight of the fatty acid thus, the high saponification number agrees v physical state of the oil at ambient temperature. Therefore the oil can be correct that it is made up of high level of low molecular weight fatty acid.

Moisture Content: The moisture content of guna seed was found to be about 3.8 ± .2%. This value is significantly low relative to other oil seeds (Table 7). Hence, the storage stability of guna seed is expected to be good. The low moisture level implies low water activity and therefore greater stability of solid constituents of the seed. For moisture content to remain low, the relative humidity (R.H.) in the storage chamber has to be maintained low about 55% (Woodroof, 1979).

Ash Content: The value of the ash content was found to be about 2.18% (table 7). The ash content reflects the mineral content of the seed. The ash content of the seed is partially a function of the soil composition on which the plant is cultivated (Woodroof, 1979).

Lipid Content: The lipid content was found to be about 46.88% for whole seed while 62% was found for decorticated (dehulled) roasted seed (Table 8). The difference is quite significant and could be attributed to the removal or decortication of bran (husk) from the seed. From Table III the bran constitute about 26.96% which contain very insignificant percentage of oil. This high lipid content of guna is enough justification for its cultivation as a cash crop rather than for soil erosion control. The oil content is apparently higher than that documented for groundnut (Table 7).

Table 7: Comparison of Guna Proximate Analysis with other oil Seed

Oil Seeds	M.C (%)	Ash (%)	C.P (%)	Lipid (%)	C.F (%)	CH2O(%)
Bambara nut	10.1	3	16.0	6	ND	65
Cowpeas	11.5	3.2	22.7	1.6	4.2	56.8
G'nut	7.3	2.4	23.4	45.3	2.1	19.5
Soyabeans	10.2	5	35.1	17.7	4.2	27.8
Guna seed	3.8 ± .2	2.18	27.2	46.88	2.6*	17.4

= decorticated seed value

M.C = moisture content
C.P = Crude protein (6.26 x N)
C.F = crude fibre
CH2O = Carbohydrate
ND = not determined

Protein Content: The protein content was found to be about 27.2%. (table VII). This compares generally with other oil seeds like groundnuts, cowpeas, and soyabeans. The value indicated that guna has a good protein content for human and livestock consumptions. This protein could be supplemented in serial based food mix for children to improve their protein content.

CONCLUDING REMARKS

The results obtained indicated a very close comparison in terms of chemical composition of guna seed with other oil seeds. The guna seed has shown significantly high content of both oil and protein. As it is cultivated mainly for the extracted, weighed on weight basis. It is more valuable than most oil seeds. Furthermore , the protein content make the by-product (cake) quite nourishing either as human and or livestock feed. The physico-chemical constant of the guna oil compares generally closely with most common vegetable oil. Hence, in terms of utility an applications, guna oil can substitute the others. Particularly when it is apparent that the cost of guna will be much lower than that of vegetable oil. In fact, even the storage stability of guna oil is not expected to be worse than any of the comparable oils. The iodine value as well as the saponification value were in agreement with other results obtained from oil seeds and from the density of the pod.

REFERENCES

Bassis I. M. (1989). *Extraction and Evaluation of Oil from Egusi Seed.* Kaduna: Government Printing Press

Daily Sketch (1981). A Nigerian News Paper. November 23rd , 8.

Davidson S., Passmore R., Brock J.F., and **Trustwell A.S.** (1975). *Human Nutrition and Dietetics.* (6th Edn) United Kingdom: The English Language Book Society and Churchill Livingstone.

Desrosier, N.W. (1977). *Elements of Food Technology.* Connecticut, USA: AVI Publication Co. Inc. Westport

Formo M.W., Jungermann E., Norris F.A. and **Sonntag N.O.V.** (1979). *Barley's Industrial Oil and Fats Products Vol. 1* (4th Edn.) Chichester: John Wiley & Sons, UK.

Hui, Y. (1992). *Encyclopedia of Food Science and Technology. Vol III.* Canada: I. P John Wiley & Sons Inc. Publication.

Ihekoronye, A. I. and **Nhoddy, P. O.** (1985). *Integrated Food Science and Technology for the Tropics.* United Kingdom: Macmillan Publication.

Nelkon, M. and **Packer, P.** (1982). *Advance Level Physics* (5th Edn.) London: Heinemann Educational Books.

Ojeih, O.A. (1981). Effect of Refining on the Physical and Chemical Properties of Cashew Kernel Oil. *Journal of Food Technology. 16 (5): 12 -15.*

Egan H., Kirk U. S. and **Sawyer R.** (1976). *Pearson's Chemical Analysis of Foods.* (7th Edn.) London: Churchill Livingstone UK.