

Quality Characteristics of Crude and Refined *Atili* Oils

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Abstract: Two varieties of “atili” fruit were extracted separately for oil by warm pressing extraction method using screw press expeller. The crude “atili” oils were refined and a bright greenish yellow colour was obtained from both varieties. The proximate analysis for long and short varieties were fat; 22.82%; 19.28%; protein 21.71%; 20.83%, ash; 3.39%; 3.06%, moisture; 30.10%; 29.00%, carbohydrate 21.98%; 27.86% respectively. There was significant difference ($p < 0.05$) in the ash and moisture content of the two varieties. There was no significant difference in the specific gravity and refractive index of both refined (long and short) varieties “atili” oil and crude (long and short) varieties “atili” oil whereas significant differences existed in all the chemical properties of the various “atili” oils.

Key words: Quality characteristics, “atili” fruit, “atili” oil (crude and refined)

Introduction

“Atili” (*Canarium schweinfurthii bursaraceae*) is the fruit of the perennial tree plant also called “atili” tree. In Nigeria, the fruit is called ‘ube okpoko’ in Ibo and “atili” in Hausa. The fruit is commonly found in large quantity in Pankshin, Plateau State of Nigeria and is also produced in similar quantities in other states of the northern and south-eastern Nigeria.

The plant produces its fruits in the rainy season (usually) between the months of April and September. The flowers grow in clusters at the end of the twigs and are small and dark green in colour. The fruits which are of two varieties-long spiral and short round in shape develop from the flowers. The fruits contain single triangular-shaped seed with small projections at the three edges. The seeds are embedded in a purplish green pulp with a desirable sweet but not too sugary taste similar to that of avocado pear. The pulp is of oily consistency and edible. The weight of the fruits ranges from 3.5 to 9 g with a predominant average weight of about 5.3 g. The fruit is very hard, the seed is cooked and yields an oil, sometimes used as a substitute for shear butter (Kochar, 1981). The fruit store best under cold storage thus, preventing moisture loss that may result in shrinkage of the fruit surface reducing its aesthetic value and also prevent microbial growth (Looney, 1985).

The importance of lipids in human diet cannot be over emphasized. In normal diet, about 20-25% of the caloric intake consist of fats and oils. These substances are the most concentrated form of energy in human diet, when metabolized, fats produce about 9.5 kcal/g (Okaka *et al.*, 2002).

Crude “atili” oil for both long and short varieties are rich in fat, protein, carbohydrate, water and sometimes ash in low quantity. In spite of its rich nutrient content, it is

cheaper than groundnut oil especially during the hot season when they are locally produced more abundantly, it is used in frying different kinds of foods such as meat, bean cake and fish. It is rich in flavour; therefore it is sprinkled on food like cooked rice and smoked fish before consumption. It is also used as an alternative ointment in healing wounds in villages around Plateau State.

Crude “atili” oil in addition to containing natural flavours, free fatty acids, pigments, moisture, trace element [metal], pro-vitamins, vitamins, naturally occurring antioxidants and enzymes, also contain dirt’s and unwanted impurities and compounds not suitable for consumption (Kordylas, 1991). Information on refined “atili” oil is not documented. There is need to exploit the potential of “atili” as a vegetable oil. The objective of this study is to extract, refine and characterize oil from “atili” fruit since it has not been exploited as source of vegetable oil.

Materials and Methods

Source of materials: Fresh “atili” fruit [long and short varieties] were purchased from Pankshin market in Plateau State, Nigeria. The chemicals were of analytical grade and purchase from Sigma or BDH Company, UK. This research was carried out in Food Science and Technology Department Federal Polytechnic Bauchi, Nigeria.

Atili oil extraction process: The warm pressing extraction method using the screw press was used for extraction of the oil (Catsberg and Dommellen, 1990). The fruits were sorted to remove any dirt or foreign material present in them. They were then washed in cold water to remove any dirt adhering to the surface of the fruits. The fruits were packed in a clean bowl and hot water at 65°C was poured into the bowl and left for 5

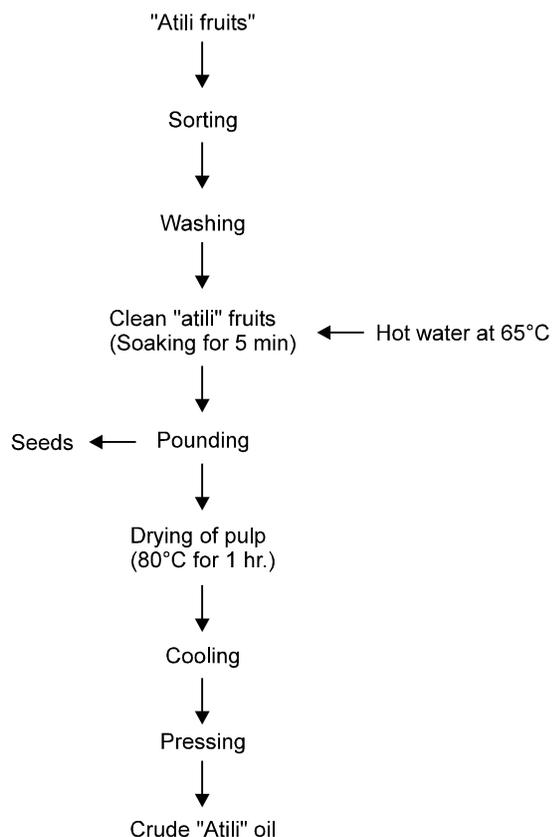


Fig. 1: "Atili" oil extraction process

mins to soften the tissue of the fruits. The seeds were then removed by beating in a mortar (1m height) with the aid of a pestle (1.5m height). The pulp was pounded using the mortar and pestle for 10mins. The pounded pulp was dried in a hot air oven at 80°C for 1 hr to remove any available free moisture. It was then cooled in a desiccator and transferred to the screw press expeller where the pulp was pressed, separating the oil from the cake. The flow chart is shown in Fig. 1.

Refining of crude "atili" oil: Degumming, neutralization, washing, bleaching and deodorization methods as described by Ihekoronye and Ngoddy (1985) were adopted in refining crude "atili" oil.

Physical properties of "atili" oil: Colour was observed with the eyes after extraction and refining. Refractive index was measured using Abbe refractometer as described by Kirk and Sawyer (1991). Specific gravity of the oil was measured using specific gravity bottle.

Chemical properties of "atili" oil: Saponification value, iodine value, soap content, acid value, free fatty acid and peroxide value were determine following the method described by Pearson (1991).

Table 1: Material balance of "atili" oil extraction^a

Long variety		Short variety	
%Cake	%oil	%Cake	%oil
72.04±1.02 ^a	27.95±1.02 ^c	75.80±0.95 ^b	22.20±0.95 ^d

^aValues are mean±standard deviation of six replicates

Proximate analysis: Fat, protein, moisture content, ash and carbohydrates were as described by Pearson (1991). The carbohydrate content was by difference. All analysis were in duplicates.

Results and Discussion

Material balance and proximate composition of "atili" oil: The material balance of "atili" oil extraction is shown in Table 1. There was significant difference in the percentage cake and oil of the two varieties of "atili" fruit. The long variety "atili" fruit gave a significant higher oil yield than the short variety "atili" fruit measured at the same weight. The short variety "atili" fruit gave a significantly higher cake yield than the long variety fruit. This higher percentage of oil from the long variety "atili" fruits could be due the fact that it contains more flesh than the short variety "atili" fruit.

The proximate composition of "atili" fruits are shown in Table 2. The long and short variety "atili" fruits has fat content of 22.62%; 19.28%, protein content of 21.71%; 20.83%, ash content of 3.39%; 3.06% moisture content of 30.1%; 29.0%and carbohydrate content of 21.98%; 27.86% respectively. There was no significant difference ($p<0.05$) in the protein, fat and carbohydrate content of the two varieties. Differences exist in the moisture and ash contents. The high content of ash, protein and fat in both varieties indicate that the fruits are rich in minerals, fat and protein. The fruits can be recommended to those with deficiency of protein, which will serve as cheap source of protein to them. The moisture content of any food is an index of its water activity (a_w) as reported by Frazier and Westoff (1978). This implies that "atili" fruits may have a short shelf-life due to their high moisture content. The varieties contain reasonable amount of carbohydrate and can serve as a source of calorie in human diet.

Physical properties of "atili" oil: The physical properties of atili" oil are shown in Table 3. Crude long variety "atili" oil was dark green while crude short variety oil was dark greenish yellow in colour. Both refined long and short varieties oil were bright greenish yellow in colour. The bright greenish yellow colour for both refined long and short varieties "atili" oils may be due to the adsorption of the colouring matter contained in the oil by activated earth (Fox and Cameron, 1984).

The specific gravity of long variety "atili" oil decreased from 0.9523 to 0.8700 after refining while the short variety decreased from 0.9607 to 0.8883 after refining.

Agu *et al.*: Quality Characteristics of Crude and Refined *Atili* Oils

Table 2: Proximate composition of "atili" fruits^{a,b}

"Atili" fruit	Fat (%)	Protein (%)	Ash (%)	Moisture (%)	Carbohydrate(%)
Long variety	22.82±0.16 ^a	21.71±0.50 ^a	3.39±0.08 ^a	30.10±0.01 ^a	21.98±0.16 ^a
Short variety	19.28±0.16 ^a	20.83±0.26 ^a	3.06±0.09 ^b	29.00±0.07 ^b	27.83±0.08 ^a

^aValues are mean±standard deviation, ^bMeans with the same superscript within the same row do not differ significantly (p<0.05) using Duncan's multiple range test

Table 3: Physical properties of "atili" oil^{a,b}

Parameters	Long variety		Short variety	
	Crude	Refined	Crude	Refined
Colour	Dark green	Bright greenish yellow	Dark greenish yellow	Bright greenish yellow
Specific gravity at 20°C/water at 20°C	0.9523±0.23 ^a	0.8700±0.15 ^a	0.9607±0.15 ^a	0.8883±0.16 ^a
Refractive index at 40°C	1.4052±0.15 ^a	1.307±0.15 ^a	1.4106±0.08 ^a	1.3900±0.15 ^a

^aValues are mean±standard deviation, ^bMeans with the same superscript within the same row do not differ significantly (p<0.05) using Duncan's multiple range test

Table 4: Chemical properties of "atili" oil^{a,b}

Parameters	Long variety		Short variety	
	Crude	Refined	Crude	Refined
Saponification value	140.50±0.31 ^a	121.64±8.87 ^b	150.40±0.31 ^b	126.65±0.31 ^b
Iodine value	96.50±0.31 ^a	88.21±0.18 ^b	95.00±0.31 ^c	87.56±0.31 ^d
Soap content (ppm)	210.20±0.31 ^a	115.67±8.18 ^a	262.40±0.31 ^b	125.50±0.31 ^c
Acid value (mg/KOH/g)	0.62±0.31 ^a	0.17±0.11 ^a	0.80±0.31 ^b	0.17±0.11 ^b
Free fatty acid (%)	1.98±0.31 ^a	1.13±0.19 ^a	1.35±0.35 ^b	1.26±0.31 ^b
Peroxide value (Meq/kg)	1.04±0.31 ^a	0.76±0.31 ^a	1.39±0.31 ^b	0.88±0.13 ^b

^aValues are mean±standard deviation, ^bMeans with the same superscript within the same row do not differ significantly (p<0.05) using Duncan's multiple range test

The decrease was not significant hence refining did not affect the specific gravity significantly. In addition, the two oils did not differ in specific gravity both in crude and at the refined form. The decrease for both varieties, may be due to the removal of gummy materials and some colouring matters, which affected the weight of the oils after refining. According to Paul and Palmer (1972), the specific gravity of different refined oils vary with their molecular weight which are affected by the refining process involved.

The refractive index of both long and short varieties decreased from 1.4052 to 1.3071 and from 1.4106 to 1.3900 respectively after refining. The decrease was not significant hence refining did not affect the refractive index significantly. In addition, the two oils did not differ in refractive index both in crude and at the refined form. The decrease for both varieties of "atili" oil could be as a result of continuous removal of impurities during the refining process. According to Pearson (1991), the amount of impurities that are contained in the oil affects the degree of deflection caused by a ray of light during refractive index determination of the oil.

The chemical characteristics of "atili" oil: The chemical properties of "atili" oil are shown in Table 4. The saponification values for both long and short varieties of "atili" oil decreased from 140.50 to 121.64 and from 150.40 to 126.65 respectively after refining. The

crude long variety was significantly different (p<0.05) from its refined form and also from short variety oil both in crude and refined form. This decrease generally could be due to the neutralization of fatty acids which may have resulted from hydrolysis of the oil samples. According to Kirk and Sawyer (1991), the number of milligrams of potassium hydroxide (KOH) used to neutralize the fatty acids determine the degree of hydrolysis of the oil sample.

The iodine value for both long and short varieties atili oil decrease from 96.50 to 88.21 and from 95.00 to 87.56 respectively after refining. The decrease was significant (p<0.05) hence refining affected the iodine value significantly. In addition, the iodine value for the two oils differ both in crude and refined form. The decrease in iodine value denotes decrease in the degree of unsaturation of the oil caused by the extent of oxidation and degree of heat treatment given to the oil during refining process (Kirk and Sawyer, 1991).

The soap content for both long and short varieties "atili" oil decrease from 210.20 ppm to 115.7 ppm and from 262.40 ppm to 125.50 ppm respectively after refining. The crude long variety was not significantly different (p<0.05) from its refined form but was significantly different from the short varieties both in crude and refined form. The short varieties (crude and refined) were also significantly different from each other. The decrease could be due to removal of fatty materials

containing traces of soap in the refining process. It could also be due to the action of sulphuric acid contained during refining. According to Bender (1990), the amount of soap content in oil is determined by the degree of the removal of free fatty acids from the oil and this permits fatty acids to settle at the bottom as alkali soaps and are known as soap content.

The acid values for both long and short variety "atili" oil decreased after refining from 0.62mg/KOH/g to 0.17mg/KOH/g and from 0.80mg/KOH/g to 0.17mg/KOH/g respectively. The decrease was significant ($p < 0.05$) hence refining affected the acid value significantly. In addition, the two oils differed in acid value both in crude and refined form. These results are expressed as the percentage of Free Fatty Acid (FFA). According to Demian (1990), these values are used to measure the extent to which glyceride in the oil has been decomposed by lipase and other actions such as light and heat and that the determination is often used as a general indication of the condition and edibility of oils.

The free fatty acid values for both long and short varieties "atili" oil decreased after refining from 1.98% to 1.13% and from 1.35% to 1.25% respectively. The crude long variety was not significantly different ($p < 0.05$) from its refined form but were significantly different from the short varieties both at the crude and refined form. This decrease could be due to the removal of some fatty materials and free fatty acid during refining process. It could also be due to the action of sulphuric acid on the oil. According to Kirk and Sawyer (1991), the presence of excess free fatty acid and other fatty materials in oil bring about the offensive odour and taste in the oil on long storage.

The peroxide values for both long and short varieties "atili" oil decreased from 1.04Meg/kg to 0.76Meg/kg and from 1.39Meg/kg to 0.88Meg/kg respectively after refining. The crude long variety was not significantly different ($p < 0.05$) from its refined form but was significantly different from the short variety both at the crude and refined form. The decrease in the peroxide value after refining both varieties as compared to their crude state may be due to the decrease in the amount of the peroxide contained in the oil as a result of the refining process. The low peroxide value showed slow oxidation of these oils. According to Demian (1990), the peroxide value is frequently used to measure the progress of oxidation in oil. During storage, peroxide formation is slow at first during an induction period, which may vary from a few weeks to several months according to the particular oil and temperature (Pearson, 1991).

Conclusion: Long variety "atili" fruit has higher percentage of oil than the short variety atili fruit. Also, the same long variety atili oil gave higher quality atili oil

when compared with the short variety atili oil.

Furthermore, both oils have characteristics that are very close to those of the recommended codex standard for vegetable oil. Therefore, based on this fact, the oil can keep for a very long time without adverse deterioration in quality of the oil. The bright greenish yellow colour of the oils can attract consumers easily thereby creating market for the product.

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References

- Bender, A.E., 1990. Dictionary of nutrition and food Technology. 6th Ed. Butterworth and company publishers Limited, pp: 260.
- Catsberg, C.M.E. and G.J.M. Dommellen, 1990. Food Hand Book Ellis Harwood Limited England, pp: 171-181.
- Demian, M.J., 1990. Principles of Food Chemistry. 2nd Ed. Van Nostrand Reinhold International Company Limited, London England, pp: 37-38.
- Fox, B.A. and A.G. Cameron, 1984. Food science, a chemistry Approach. 4th Ed Holder and Strongton limited London, pp: 112-116.
- Frazier, W.C. and D.C. Westoff, 1978. Food microbiology. 3rd Ed. Tata McGraw-Hill publishing company limited New York, pp: 170.
- Ihekoronye, A.I. and P.O. Ngoddy, 1985. Integrated Food Science and Technology for the Tropics. 1st Ed. Macmillan Publishers Limited, London, pp: 58-59.
- Kirk, R.S. and R. Sawyer, 1991. Pearson's Composition and Analysis of Foods. 9th Ed. Longman Scientific and Technical England, pp: 607-617.
- Kochar, S.L., 1981. Tropical Crops. A textbook of economy Botany, Macmillan publishers New York, pp: 214-217.
- Kordylas, J.M., 1991. Processing and Preservation of Tropical and Subtropical Foods. Macmillan Education Limited, London and basing stock, pp: 115-159.
- Looney, R.F., 1985. Oils and Fats. Materials and Technology Vol. 8, Longman D. Bussey, London, pp: 1-56.
- Okaka, J.C., E.T.N. Akobundu and A.N.C. Okaka, 2002. Human Nutrition; An Integrated Approach. 2nd Ed. Enugu State University of Science and Technology, Enugu, pp: 77-85.
- Paul, P.C. and H.H. Palmer, 1972. Food Theory and Applications. John Wiley Palmer, H.H. and sons incorporated, New York, pp: 217-219.
- Pearson, D., 1991. The chemical analysis of foods. 7th Ed. Church Livingstone Longman group limited, pp: 493-494.