Research Journal of Applied Sciences, Engineering and Technology 2(1): 60-66, 2010
ISSN: 2040-7467

Submitted Date: November 04, 2009 Accepted Date: November 16, 2009 Published Date: January 05, 2010

Proximate Composition of Selected Congo Oil Seeds and Physicochemical Properties of the Oil Extracts

[1]A. Kimbonguila, [1,4]J.M. Nzikou, [1]L. Matos, [3]B. Loumouamou, [1]C.B. Ndangui, [1]N.P.G. Pambou-Tobi, [2]A.A. Abena, [3]Th. Silou, [4]J. Scher and [4]S. Desobry
[1]ENSP-UMNG, Laboratory of Food Physicochemistry and Biotechnology, Pole of Excellence in Nutrition and Food, P.O. Box 69 Brazzaville-Congo
[2] Laboratory of Biochemistry and Pharmacology, Faculty of Science of Health, P.O. Box 69 University Marien Ngouabi, Brazzaville – Congo
[3]Equipe pluridisciplinaire de recherche en alimentation et nutrition, Centre IRD .P.O. Box 1286 Pointe-Noire, Congo
[4]ENSAIA-INPL, Laboratory of engineering and biomolecule, 2, avenue de la forêt de Haye, 54505 Vandoeuvre-lès-Nancy, France

Abstract: Proximate composition, energy content and mineral concentrations of oil seeds which can be used in the preparation of Congolese diets were investigated. The paper also reports the physicochemical characteristics of the oil extracts from the seeds. Moisture content (on dry weight basis) was highest (9.45 ± 0.8%) in gumbo (*Abelmoschus esclentus*) seeds (AES), followed by amarenthus hybridus seeds (AHS) (9.07 ± 0.84%) but was lowest (4.13 ± 0.24%) in terminalia catappa seeds (TCS). Ash was highest (7.18 ± 0.97%) in solanum nigrum L seeds (SNS) followed by gumbo (*Abelmoschus esclentus*) seeds (AES) with a value of 5.68 ± 0.12% and was lowest (3.7 ± 0.97%) in sesame (SIS). Protein ranged from 37.6 ± 1.07% in moringa olifeira (MOS) to 17.04 ± 0.67% in SNS. Sesame seed (SIS) had the highest crude fat of 54 ± 0.16%, followed by TCS (51.80 ± 0.21%) and the lowest value of 10.57 ± 0.05% in AHS. Values for SIS and TCS did not differ significantly. Total carbohydrates were generally low in all the seeds and ranged from 13.6% in MOS to 36.58% in AES, only the AHS has a high total carbohydrate value (58.31%). The oil seeds were found to be good sources of minerals. The physical properties of the oil extracts showed the state to be liquid at room temperature (20±1 ºC). All the studied oil samples contain the oleic and linoleic acids, these oils can be classified in the oleic-linoleic acid group. It can be inferred that the oil seeds investigated (except AHS which has a weak oil yield environ 10%) are good sources of crude fat, crude protein, ash, energy and minerals. The oil extracts exhibited good physicochemical properties and could be useful as edible oils and for industrial applications.

Key words: Concentrations, DSC, fatty acid, mineral, oils seeds and viscosity

INTRODUCTION

Oil seeds which can be used in the preparation of diets abound in Congo. In Congo, *gumbo (Abelmoschus esculentus)* seeds (AES), *Solanum nigrum* L seeds (SNL), *amarenthus hybridus* seeds (AHS), *moringa olifeira* seeds (MOS), *jatropha curcas* seeds (JCS), sesame seeds (SIS) and *terminalia catappa* seeds (TCS) which can be used in the preparation of diets.

AES (*Abelmoschus esculentus*) is widely consumed as a fresh vegetable in both temperate and tropical countries. Although the seed pods are most often used (Camciuc *et al.,* 1998), the mature seed is known to have superior nutritional quality. Rubatzky and Yamaguchi (1997) reported that the seed is a rich source of protein and oil.

The *Solanum nigrum* L (SNL) valorization passes by the edible oil extraction from its seeds and obtaining the oil cakes containing of proteins having interesting functional proprieties. *Solanum nigrum* L. still called Morelle black is an annual herbaceous plant from 10 to 60 cm in height to green, smooth stem and more or less climbing. The opposed sheets, with whole limb, ovals in rhombus are cogged a little. Il is a rather common species in wood wet, at the edges of water and the old walls. One meets it a little everywhere in Africa, America and France. In India *Solanum nigrum* L. mixed with other medicinal plants has a hepatic protective effect on the patients reached of cirrhosis and this effect is due to its antioxidant action, diuretic, anti-inflammatory drug and immune modulating (Fallah *et al.*, 2005). It also protects from the viral infection from hepatitis B (De Silva *et al.*, 2003; Galitskii *et al.*, 1997; Kalab and Kerchler, 1997).

The genus *Amaranthus hybridus* has received considerable attention in many countries because of the

Corresponding Author: J.M. Nzikou, ENSP-UMNG, Laboratory of Food Physicochemistry and Biotechnology, Pole of Excellence in Nutrition and Food, P.O. Box 69 Brazzaville-Congo

high nutritional value of some species that are important sources of food, either as vegetable or grain. The leaves contain 17.5 to 38.3% dry matter as protein of which 5% is lysine (Oliveira and De Carvallo, 1975). Vitamin A and C are also present in significant levels. One hundred grams of the vegetable material cooked without oil can contribute 45% of daily Vitamin A requirement (Mulokozi *et al.*, 2004 as quoted by FAO 2004). Compared to spinach, *Amaranthus hybridus* contains three times more vitamin C, calcium and niacin. Compared to lettuce, *Amaranthus hybridus* contains 18 times more vitamin A, 13 times more vitamin C, 20 times more calcium and 7 times more iron (Guillet, 2004). A study by Allemann *et al.* (1996) showed that amaranth has the potential to be a valuable source of nutrition in areas in Africa with hot, dry climates. The crop can grow on marginal lands and when it gets well established it can withstand acute drought conditions.

Moringa oleifera belongs to the Moringaceae family and Moringa genus, the best known and most widely distributed species (Morton, 1991; Sengupta *et al.*, 1970). There are a few known varieties namely Jaffna, Chauakacheri Murunga, Chem, Kadu, Palmurungai, Periyakulam 1 (PKM 1) (Tsaknis *et al.*, 1998), and Peregrina (Somali *et al.*, 1984). The edible oil was extracted, where the tree is cultivated, by boiling the seeds with water and collecting the oil from the surface of the water (Somali *et al.*, 1984). The seed oil contains all the fatty acids contained in olive oil, except linoleic and was used as its acceptable substitute (Morton, 1991). *Moringa oleifera* "Congo-Brazzaville" is a selection of local types and is propagated only by seed. Until now a full characterization of the oil produced from the seeds of *Moringa oleifera* "Congo-Brazzaville" has not been reported.

Jatropha curcas (euphorbiacée called pinion of India) is a species originating in the Indies and currently widespread in the villages of tropical Africa (Adjanohoum *et al.*, 1989). In Congo, this plant is found in almost all the areas. The population uses it for the clothes industry of the fences and in the pharmacopeia, in reason of its many therapeutic virtues (Kerharo, 1974). *Jatropha curcas*, is a drought resistant tropical tree and the oil from its seeds has been found useful for medicinal and veterinary purposes, as insecticide, for soap production and as a fuel substitute (Gubitz *et al.*, 1999).

Sesame (*Sesamum indicum* L.) is one of the most important oilseed crops worldwide, and has been cultivated in Korea since ancient times for use as a traditional health food. Sesame seeds are used in the making of tahin (sesame butter) and halva, and for the preparation of rolls, crackers, cakes and pastry products in commercial bakeries. There are numerous varieties and ecotypes of sesame adapted to various ecological conditions. However, the cultivation of modern varieties is limited due to insufficient genetic information. Many farmers continue to grow local sesame (Souza *et al.*, 1991), bean (*Phaseolus vulgaris* L.) (Singh *et al.*, 1991), cotton (*Gossypium hirsutum* L.) (Brown, 1991), Triticales (Royo *et al.*, 1995), soybean (*Glycine max* L.) (Perry *et al.*, 1991) and biserrula (*Biserrula pelecinus* L.) (Loi *et al.*, 1997).

Terminalia catappa L. Believed to have originated in Malaysia, this tree is generally confined to mesic and wet coastal habitats and is distributed throughout the Old World tropics and tropical America (Morton, 1985). Reaching heights of 15 to 25 m, *T. catappa* shows strong salt-, drought- and wind-tolerance and produces fruit (5-10 cm long) with a thin flesh surrounding a large fibrous nut. While the fleshy fruit is the target of larval infestation, *T. catappa* leaf extracts have also been shown to preferentially attract female oriental fruit flies (Chen and Dong, 2000). Clarke *et al.,* (2001) found that *T. catappa* along with *Psidium guajava* L. constituted the major hosts for *B. dorsalis* in a survey of Thailand and Malaysia. In addition, *T. catappa* reared a particularly high number of larvae in proportion to the weight and number of fruit sampled, leading to the suggestion that it is a "primary native host" in the surveyed areas (Clarke *et al.*, 2001).

There is inadequate information about the nutrient status of these oil seeds, and the physicochemical properties of the oil extracts. The present study therefore reports the proximate composition, energy value and mineral concentrations of these oil seeds, used in the preparation of Congolese diets, and the physicochemical characteristics of the oils extracted from these seeds.

MATERIALS AND METHODS

This study was led to the laboratory of engineering and biomolecule of the ENSAIA-INPL, Vandoeuvre –lès-Nancy (France) for the period of Jan. 4, 2008 to Feb. 27, 2009.

Samples: All the seeds (gumbo, solanum nigrum, amarenthus hybridus, moringa olifeira, jatropha curcas, sesame and terminalia catappa), each lot 800 g, were purchased from Bacongo Total market. The samples were wrapped in black cellophane bags, sealed in air-tight containers and stored in a refrigerator (4 ºC) for 2 days prior to processing for analyses.

Sample preparation: Five hundred grammes of each of the eight samples were ground in a Moulinex Model SeB PREP'LINE 850 (Moulin cafe). Each paste was wrapped in a black polyethylene bag and stored in an air-tight sample bottle in a refrigerator (4 ºC) for 4 days before analyses.

Methods: Proximate analysis of all the seeds (gumbo, solanum nigrum, amarenthus hybridus, moringa olifeira, jatropha curcas, sesame and terminalia catappa) Moisture, crude protein (micro-Kjeldahl), crude fiber and oil

(Soxhlet) contents were determined using the methods described by Pearson (1976), whereas the ash content was determined using the method of Pomeranz *et al,*. (1994), and total carbohydrate was determined by difference. All determinations were done in triplicate.

Oil extraction: For solvent extraction (soxlhet method), 50g of each of the eight samples of ground seeds were placed into a cellulose paper cone and extracted using light petroleum ether (b.p 40–60 ºC) in a 5-l Soxhlet extractor for 8 h (Pena *et al.*,1992). The oil was then recovered by evaporating of the solvent using rotary evaporator Model N-1 (Eyela, Tokyo Rikakikal Co., Ltd., Japan) and residual solvent was removed by drying in an oven at 60 ºC for 1 h and flushing with 99.9% nitrogen.

Physical and chemical analysis of crude oil:
Thermal behaviour: The thermal property of the oil samples was investigated by differential scanning calorimetry using a Perkin–Elmer Diamond DSC (Norwalk,USA). The instrument was calibrated using indium and zinc. The purge gas used was 99.99% nitrogen with a flow rate of 100 $ml.min^{-1}$ and a pressure of 20 psi. Sample weights ranged from 5–7 mg and were subjected to the following temperature program: Frozen oil sample was heated at 50 ºC in an oven until completely melted. Oil sample was placed in an aluminium volatile pan and was cooled to -50 ºC and held for 2 min, it was then heated from - 50 to 50 ºC at the rate of 5 $ºC.min^{-1}$ (normal rate) (Che Man et *al.*, 1995) and 2.5 $ºC.min^{-1}$ (past rate), and held - 50 ºC isothermally for 2 min and cooled from -50 to 50 ºC at the rate of 5 ºC per minute. The heating and cooling thermograms for the normal and the fast (hyper DSC) scan rates were recorded and the onset, peak, and offset temperatures were tabulated. These values provide information on the temperature at which the melting process starts, the temperature at which most of the TAG have melted, and the complete melting temperature of the oil, respectively.

Viscosity measurements: A rheometer as described by Nzikou *et al.*, (2007) was used to measure the different oil viscosities. By this procedure, a concentric cylinder system is submerged in the oil and the force necessary to overcome the resistance of the viscosity to the rotation is measured. The viscosity value, in mPas, is automatically calculated on the basis of the speed and the geometry of the probe. Temperature (20 ºC was controlled with a water bath connected to the rheometer. The experiment was carried out by putting 3 ml of sample in a concentric cylinder system using 100 s^{-1} as shear rate.

Chemical analysis: Determinations for peroxide, iodine, saponification values, unsaponifiable matter and free fatty acid contents were carried out using Pena *et al.*, (1992) standard analytical methods. The fatty acid composition was determined by conversion of oil to fatty acid methyl esters prepared by adding 950 µl of n-hexane 50 mg of oil followed by 50 µl of sodium methoxide using the method of Cocks *et al.*, (1966). The mixtures were vortex for 5 s and allowed to settle for 5 min. The top layer (1 µl) was injected into a gas chromatograph (Model GC- 14A, Shimadzu Corporation, Kyoto, Japan) equipped with a flame-ionisation detector and a polar capillary column (BPX70 0.25), 0.32 mm internal diameter, 60 m length and 0.25 µm film thickness (SGE Incorporated, USA) to obtain individual peaks of fatty acid methyl esters. The detector temperature was 240 °C and column temperature was 110 °C held for one minute and increased at the rate of 8 $°C.min^{-1}$ to 220 ºC and held for one minute. The run time was 32 min. The fatty acid methyl esters peaks were identified by comparing their retention time with those of standards. Percent relative fatty acid was calculated based on the peak area of a fatty acid species to the total peak area of all the fatty acids in the oil sample. The minerals were determined by atomicabsorption spectrophotometry. One gram samples, in triplicate, were dry ashed in a muffle furnace at 550 ºC for 8 h until a white residue of constant weight was obtained. The minerals were extracted from ash by adding 20.0 ml of 2.5% HCl, heated in a steam bath to reduce the volume to about 7.0 ml, and this was transferred quantitatively to a 50 ml volumetric flask. It was diluted to volume (50 ml) with deionised water, stored in clean polyethylene bottles and mineral contents determined using an atomic absorption spectrophotometer (Perkin-Elmer, Model 2380, USA). These bottles and flasks were rinsed in dilute hydrochloric acid (0.10 M HCl) to arrest microbial action which may affect the concentrations of the anions and cations in the samples. The instrument was calibrated with standard solutions.

Statistical analyses: Data were analyzed by one way analysis of variance (ANOVA). Means were compared by the Duncan's (1955) multiple range test; significance was accepted at 5% level ($P \leq 0.05$).

RESULTS AND DISCUSSION

The proximate compositions of the oil seeds analyzed are presented in Table 1. Moisture content was highest (9.45 ± 0.8%) in gumbo seeds (AES), followed by Amarenthus hybridus seeds (AHS) having a value of 9.07 ± 0.84% and was lowest (4.13 ± 0.24%) in terminalia catappa seeds (TCS), though the value for TCS did not differ significantly than those of moringa olifeira seeds (MOS) and jatropha curcas seeds (JCS) at the 5% level. The low moisture levels of those eight samples could store for a longer time without spoilage, since a higher moisture content could lead to food spoilage through increasing microbial action (Onyeike *et al.*, 1995). Ash content was highest (7.18 ± 0.97%) in solanum nigrum seeds (SNS) but the value did not differ significantly from those of others samples and was lowest (3.7 ± 0.97%) in

Table 1: Proximate composition (%) of selected oil seeds which can used in the preparation of Congolese diets[a]

Constituents	AES	SNS	AHS	MOS	JCS	SIS	TCS
Moisture content	9.45±0.8c	8.47±0.01a	9.07±0.84c,d	5.3±1.05d	5.12±0.4b	5.7±0.24a	4.13±0.24b
Crude protein	24.85±1.5a	17.04±0.67c	17.19±1.47b,c	37.6±1.07a	25±0.20e	20±0.12a,b	23.78±0.15c
Crude fat	23.44±012b	34.5±2.4c	10.57±0.05a	39.3±1.06a	48.50±0.18c	54±0.16c	51.80±0.21b
Ash content	5.68±0.12c	7.18±0.97e	4.86±0.08b	4.2±0.30b	4.2±0.29b	3.7±0.97b	4.27±0.74a
Total Carbohydrate	36.58	32.81	58.31	13.6	17.18	16.6	16.02

[a]Values are mean±S.D of triplicate determinations. Values in the same row having the same letter are not significantly different at 5% level.
Abbreviations: AES: Gumbo (*Abelmoschus esculentus*) , SNS: Solanum nigrum, AHS: Amarenthus hybridus L, MOS: Moringa olifeira, JCS: Jatropha curcas L., SIS : Sesame (*Sesamum indicum* L.), TCS : Terminalia catappa

Table 2: Mineral concentrations (mg/100g) of selected oil seeds which can be used in the preparation of Congolese diets[a]

	Concentrations						
Mineral	AES	SNS	AHS	MOS	JCS	SIS	TCS
Magnesium, Mg	2960±0.18e	179.3±1.4e	596.73±0.31e	251.30±0.02b	483.30±0.02a	579.53±0.42c	798.6±0.32d
Calcium, Ca	77.78±2.42e	11.1±0.01a	17.36±0.29d	83.75±0.01c	455.38±3.14d	415.38±3.14c	827.20±2.18b
Potassium, K	107.55±0.78c	37.21±0.52b	33.5±3.14a	36.53±0.02e	518.35±0.44d	851.35±3.44a	9280±0.14e
Soduim, Na	46.89±033c	7.12±0.02d	7.82±0.84b	22.50±0.01e	30.29±0.21c	122.50±4.21e	27.89±0.42d

[a]Values are mean±S.D of triplicate determinations. Values in the same row having the same letter are not significantly different at 5% level.
Abbreviations: AES: Gumbo (*Abelmoschus esculentus*) , SNS: Solanum nigrum, AHS: Amarenthus hybridus L, MOS: Moringa olifeira, JCS: Jatropha curcas L., SIS : Sesame (*Sesamum indicum* L.), TCS : Terminalia catappa

Table 3: Physical and chemical properties of oil extract from selected oil seeds which can be used in the preparation of Congolese diets[a]

Parameter	AES	SNS	AHS	MOS	JCS	SIS	TCS
PV	3.21± 0.14c	5.13±0.02c	3.55±0.07a	1.67±0.84b	0.21±0.44c	0.06±0.35e	0.51±0.35c
FFA (as % oleic acid)	3.74± 0.9a	2.35±0.3b	2.84±0.02d	2.10±0.10b	2.24±0.17a,c	1.80±0.10a	2.42±0.27a
IV (Wijs)	127.2± 3.12c	102.33±0.86a	111.36±2.87c	66.2±1.12e	102.43±1.12e	117.2±1.42a	82.43±1.1c
Saponification value	196.3± 5.3b	170.69±3.7c,d	157.91±2.34b	167±0.81a	169±0.81c	197±0.21c	207±0.13b
Unsaponifiable matter content (%)	1.58± 0.07b	1.27± 0.58 e	1.92±0.21d,e	0.87±0.07d	0.9±0.05d	1.87±0.48d	0.50±0.05b
Viscosity (mPa.s) at 20ºC	39.10±0.29c	25.64±0.12a	34.26±0.32d	49.96±0.20a	48.35±0.27c	29±0.10a	32.92±0.17d

[a]Values are mean±S.D of triplicate determinations. Values in the same row having the same letter are not significantly different at 5% level.
Abbreviations: PV: Peroxide Value, FFA: Free Fatty Acid, IV: Iodine Value, AES: Gumbo (*Abelmoschus esculentus*) , SNS: Solanum nigrum, AHS: Amarenthus hybridus L, MOS: Moringa olifeira, JCS: Jatropha curcas L., SIS : Sesame (*Sesamum indicum L.*), TCS : Terminalia catappa

SIS (sesame). Crude protein was highest (37.6 ± 1.07%) in MOS followed by JCS (25 ± 0.20%) and was lowest in SNS (17.04 ± 0.67%). The concentrations of protein in the seeds analyzed suggest that MOS, JCS, AES and TCS can contribute to the daily protein need of 23.6 g for adults, as recommended by the National Research Council (1974). Crude fat ranged from 10.57 ± 0.05% in AHS to 54 ± 0.16% in SIS. Values for SIS, TCS and JCS were not different at the 5% level; nor were those for MOS and SNS, but each was significantly lower than that of SIS, TCS and JCS. These values indicate that except for Amarenthus hybridus seeds (AHS) which has poor yield out of oil, all the studied seeds are good oleaginous seeds, particularly in comparison with soya with a value of 19% (Oyenuga, 1968) and African bean of yam of China with a content of grease of 2.50% (Edem *et al.*, 1990).These seeds are therefore good sources of edible oils that can be used in cooking and in the manufacture of soap as they congeal when exposed to air, probably due to the presence of saturated fatty acids. The oils can also find use in cosmetic industries and in the manufacture of margarine. Total carbohydrate ranged from 13.6% in MOS to 58.31% in AHS but was generally low (except AHS), due to the high levels of crude fat and crude protein.

Mineral concentrations of the oil seeds are shown in Table 2. Significant variations occurred in mineral concentrations among the samples analyzed. Magnesium was highest in AES (2960 ± 0.18mg/100 g), followed by TCS (798.6 ± 0.32mg/100 g) and was lowest in SNS (179.3 ± 1.4mg/100 g). Calcium ranged from 11.1 ± 0.01mg/100 g in SNS to 827.20 ± 2.18mg/100 g in TCS. TCS had the highest concentrations of Calcium and Potassium. Calcium and Sodium were lowest in SNS and AHS. Magnesium and Potassium were highest in SIS while potassium was highest in JCS (518.35 ± 0.44mg/100 g) and lowest in AHS (33.5 ± 3.14mg/100 g). These oil seeds are, in general, good sources of minerals, especially Magnesium, Calcium, Potassium and Sodium, and are therefore recommended for use in the preparation of diets of individuals with low levels of these cations and anions.

The results of some physicochemical properties of the oil extracts of the oil seeds analyzed are presented in Table 3. The state at room temperature (20.0± 1 ºC) was generally liquid. The peroxide value of all the oils is includes between 0.06 and 5.13 méq O2/kg. The peroxide values are lower than 10 méq O2/kg, which characterize the majority of conventional oils (Codex Alimentairus, 1993). These oils also present low values of free fatty acid

Table 4: Melting behavior of selected oil seeds which can be used in the preparation of Congolese diets Experimental conditions: temperature program set at -50°C at rate of 5°C.min^{-1}.

	$5°C.min^{-1}$						
Thermogram	AES	SNS	SNS	MOS	JCS	SIS	TCS
Peak 1 [°C]	-23.28	-22.5	-32.2	-31.10	-31.54	-47.71	-19.75
H_f [J.g^{-1}]	+6.05	+6.1	+5.40	-5.36	-5.91	+2.11	+1.47
Peak 2 [°C]	-1.14	-11.6	-22.23	-7.03	-10.11	-29.69	+4.56
H_f [J.g^{-1}]	+6.87	+1.31	+0.93	+49.56	+0.42	+40.75	+8.64
Peak 3 [°C]	+2.93	-	+18.96	+6.30	-1.54	-6.61	-
H_f [J.g^{-1}]	+2.18	-	+9.45	+0.55	+0.50	+0.54	-

Abbreviations: AES: Gumbo (*Abelmoschus esculentus*) , SNS: Solanum nigrum, AHS: Amarenthus hybridus L, MOS: Moringa olifeira, JCS: Jatropha curcas L., SIS : Sesame (*Sesamum indicum L.*), TCS : Terminalia catappa

(%FFA), between 2 and 3 as % acid oleic. It can deduce thus that all oils obtained would store during a longer time without being deteriorated.

The nutritional value of a fat depends, in some respects, on the amount of free fatty acids (e.g. butyric acid in butter) which develop. In the tropics, where vegetable oils are the most common dietary lipid, it has been shown that it is desirable to ensure that the free fatty acid content of cooking oil lies within limits of 0.0–3.0% (Bassir, 1971). The low levels of % FFA, in all the oils investigated, indicate that the oils are good edible oils that may store for a long time without spoilage via oxidative rancidity. The low free fatty acid values of *Telfaria occidentalis* (1.10±0.2), *Chryosophyllum albidum* (1.81 ±0.1) and *Cola rostrata* (5.0±0.20) seed oils have been reported to support the view that these oils are edible oils and could have long shelf lives (Dosunmu and Ochu, 1995).

All the iodine values of the oils investigated were includes between 66.2 and 127.2; these values show that these oils are unsaturated, in comparison with that of the pulp of *Dacryodes edulis* (60-85) (Omoti and Okyi, 1987; Kapseu and Parmentier, 1997), *Coula edulis* (90 – 95) and *Canarium schwenfurthii* (71 – 95) (Kapseu *et al.*, Abayeh *et al.*, 1999). It is therefore reasonable to assert that, all the oils investigated, with the high iodine values would undoubtedly contain more unsaturated bonds and can thus be grouped as a drying oil a feature which, according to Dosunmu and Ochu (1995), could favour the utilization of the oil in the paint industry where unsaturated oils are needed. Saponification number not varied significantly among the oils investigated. Saponification values of AES and SIS are almost identical. In the same way for SNS, JCS and MOS. sample AHS presents the low saponification value (157.91 ± 2.34). Saponification value was highest in TCS oil, followed by SIS and AES oils. All the oils have high saponification values in the order TCS>SIS>AES>SNS>JCS>MOS>AHS. Because there is an inverse relationship between saponification number and weight of fatty acids in the oil, it can be inferred as reported by Dosunmu and Ochu (1995) that the oils contain a great number of fatty acids of low molecular weight, and can thus be employed in the soap industry and in the manufacture of lather shaving creams (Eka,1980 and Hilditch1949).Unsaponifiable matter values of the oils investigated were varies between 0.5and 1.98%; these values show that these oils are rich in matter unsaponifiable and can find their application in cosmetic industry for the manufacture of the beauty products.

At 20ºC, the viscosity of these oils studied varies between 29.10 and 49.96 mPa.s characterizing unsaturated oils. The oil extracted by MOS (49.96 ± 0.20 mPa.s) Seed was more viscous, followed of JCS (48.35 ± 0.27 mPa.s); the least viscous oil was obtained by SIC seeds (29.10 ± 0.15 mPa.s), which is coherent with the high iodine value; more, oil is unsaturated, more viscosity value decreases.

DSC is suitable to determine these physical properties. The results of thermal analysis of oils are presented in Table 4. Five studied oil samples (AES, AHS, MOS, JCS and SIS) show the presence of three peaks of fusion for each sample. The first peaks at low melting point of these five samples appear in the interval of temperature (-47.71– -23.28 ºC), they correspond to the polyunsaturated fatty acids. The second melting points are between (-29.69 – -1.14 ºC), characteristic of the monounsaturated fatty acids and finally the third peaks leave in the interval (-6.61 – +18.96), suggest the presence of mixed triglycerides groups with different melting points. On the other hand, two other samples (SNS and TCS) show the presence of two peaks for each sample. The first peaks are in the interval of (-22.5– -19.75ºC). These peaks characteristic of are composed at low melting points polyunsaturated fatty acids (PUFA) and the last are between (-11.6 – + 4.56ºC), corresponding to presence of mixed triglycerides groups with different melting points.

The major saturated fatty acids in all oils were palmitic and stearic acids; the main unsaturated fatty acid were oleic and linoleic acid (Table 5). In all studied oils, they are rich in poly unsaturated fatty acids. It is shown that these polyunsaturated acids have stimulative effects on the cognitive function in the mammals and are major components of the membranes neurales, they improve the vision, the neurotransmission and the faculty of training in the children (Anon., 1990). All the studied oil samples contain the oleic and linoleic acids, these oils can be classified in the oleic-linoleic acid group. Linoleic acid

Table 5: Comparison of the profile in fatty vegetable oil acids of selected oil seeds which can be used in the preparation of Congolese diets

Oils	C14 :0	C14 :1	C16 :0	C16 :1	C17:1	C18:0	C18 :1	C18 :2	C18 :3	C20 : 0	C20:5	C22:0	C24:0	C22:6w3
AES	0.3	-	25.79	0.37	0.29	2.7	24.61	42.78	2.06	0.4	-	-	-	-
SNS	-	-	10.26	-	-	4.63	15.89	67.8	1.13	-	-	-	-	-
AHS.	-	-	16.51	-	-	2.61	28.55	37.47	0.65	0.5	0.28	-	-	11.76
MOS	-	-	6.24	1.6	-	4.61	74.93	0.72	-	3.1	-	5.33	1.05	-
JCS	-	-	15.6	1.0	-	5.8	40.1	37.6	-	-	-	-	-	-
SIS	-	-	8.66	-	-	5.45	38.86	46.18	-	0.9	-	-	-	-
TCS0.3	-	-	35.81	-	-	4.14	31.65	29.40	-	-	-	-	-	-

Abbreviations: AES: Gumbo (*Abelmoschus esculentus*), SNS: Solanum nigrum, AHS: Amarenthus hybridus L, MOS: Moringa olifeira, JCS: Jatropha curcas L., SIS : Sesame (*Sesamum indicum* L.), TCS : Terminalia catappa

which is one of the most important polyunsaturated fatty acids in human food because of its prevention of distinct heart vascular diseases (Boelhouwer, 1983). MOS contains a substantial quantity of behenic acid (5,33%) and AHS presents a percentage of 11.76% of DHA (docosahexaenoic acid). Docosahexaenoic acid (DHA) is essential for the growth and functional development of the brain in infants. DHA is also required for maintenance of normal brain function in adults (Lloyda and Youngk, 1999).Unsaturated total fatty acids are prevalent in all studied oils (Table 5). This prevalence of the unsaturated fatty acids and the high iodine values indicate that these oils extract from oil seeds Congo-Brazzaville is of the unsaturated type.

CONCLUSION

The seven oil seeds studied are, in general, good sources of crude fat, crude protein, ash and calorie. The mineral concentrations are high, especially those of magnesium, calcium and, potassium. Percent free fatty acids in the oils were below the maximum desirable limit of 5.0%; acid and peroxide values were low and these qualify them as good edible oils. High iodine values in all oils imply that these oils are rich in polyunsaturated fatty acids; All the studied oil samples contain the oleic and linoleic acids, these oils can be classified in the oleic-linoleic acid group. This prevalence of the unsaturated fatty acids and the high iodine values indicate that these oils extract from oil seeds Congo-Brazzaville is of the unsaturated type.

ACKNOWLEDGMENT

The authors thank Carole Jeandel and Carole Perroud, members of the laboratory of engineering and biomolecule of ENSAIA (Nancy-France), of their collaboration in experimental work.

REFERENCES

Abayeh, O.J., A.K. Abdulrazak and R. Olaogun, 1999.Quality characteristics of Canarium schweinfurthii Engl.oil. Plant Foods Hum. Nutr., 54(1): 43-48.

Adjanohoum, E.J., *et al.*, 1989. Contribution to the ethnobotanic studies in people's Republic of Benin, pp. 250.

Allemann J., Vander Heervere and A. Viljoena, 1996. Evaluation of Amaranthus as a possible vegetable crop. Appl. Plant Sci., 10: 1-4

Anon., 1990. Health and social Wellbeing Canada: Recommendations on the nutrition... a call to the action. Summary report/ratio of the scientific Committee of revision and the Committee of the communications and the implementation. Minister for the Provisioning and Services Canada, Ottawa.

Bassir, O., 1971. Handbook of Practical Biochemistry. 2nd End., Ibadan University Press, Ibadan, Nigeria.

Boelhouwer, C., 1983. Trends in chemistry and technology of lipids. J. Am. Oil Chem. Soc., 60 (2): 457-462.

Brown, J.S., 1991. Principal Component and Cluster Analyses of Cotton Cultivar Variability across the U.S. Cotton Belt, Crop Sci. 31: 915-922.

Camciuc M., M. Deplagne, G. Vilarem and A. Gaset, 1998. Okra-*Abelmoschus esculentus* L. (Moench.) a crop with economic potential for set aside acreage in France. Indust. Crops Prod., 7: 257-264.

Che Man, Y. B. and P. Z. Swe, 1995. Thermal analysis of failed-batch Palm oil by differential scanning calorimetry. J. Am. Oil Chem. Soc., 72(12): 1529-1532

Chen, C.C., and Y.J. Dong, 2000. Attraction of the Oriental fruit fly (*Bactrocera dorsalis* Hendel) (Diptera: Tephritidae), to leaf extracts of five plants. Chinese. J. Entomol., 20: 37- 44.

Clarke, A.R., A. Allwood, A. Chinajariyawong, R.A.I. Drew, C. Hengsawad, M. Jirasurat, C. Kong Krong, S. Kritsaneepaiboon and S. Vijaysegaran, 2001. Seasonal abundance and host use patterns of seven *Bactrocera* Macquart species (Diptera: Tephritidae) in Thailand and Peninsular Malaysia. Raffles B. Zool. 49: 207- 220.

Cocks, L.V. and C. Van Rede, 1966. Laboratory handbook for oil and fats analysts. London: Academic Press, pp: 88.

Codex Alimentairus Commission, 1993. Vegetable greases and oils, Division11, shortened version FAO/WHO Stan Codex. 20-1981, 23-1981.

De Silva, H.A., P.A. Saparamadu, M.I. Thabrew, A. Pathmeswaran, M.M. Fonseka and H.J. De Silva, 2003. Liv–52 in alcoholic liver disease: A prospective, controlled trial. J. Ethnopharmacol., 84: 47-50.

Dosunmu, M.I. and C. Ochu, 1995. Physicochemical properties and fatty acid composition of lipids extracted from some Nigerian fruits and seeds. Global J. Pure. Appl. Sci., 1(12): 45-50.

Duncan, D.B., 1955. Multipe range and multiple F tests. Biometrics, 11: 1-42.

Edem, D.O., C.I. Amugo and O.U. Eka , 1990. Chemical composition of yam beans (*Sphenostylis sternocarpa*). Trop. Sci., 30: 59-63.

Eka, O.U., 1980. Proximate composition of bush mango tree and some properties of dikafat. Nigerian J. Nutrit. Sci., 1(1): 33-36.

Fallah, H., S.M. Alavian, R. Hesmat, M.R. Heydari and K. Abolmaali, 2005. The efficacy of Liv-52 on liver cirrhotic patients: A randomized, double-blind, placebo-controlled first approach. Phytomedicine, 12: 619-624.

FAO/WHO, 2004. African Leafy Vegetables: Their roles in the World Health Organization's Global Fruit and vegetable Initiative. Available at: http://www.ipgrii.cgiar.org/Events/nutrition/Related.html (Accessed on 23/05/2006).

Galitskii, L.A., O.D. Barnaulov, B.V. Zaretskii, M.I. Malkov, S.I. Konenkov, N.P. Gohn, V.S. Tomakov, P.I. Ogarkov and S.S. Batskov, 1997. Effect of phytotherpy on the prevention and elimination of hepatotoxic reponses in patients with pulmonary tuberculosis, carriers of hepatitis B virus markers. Probl. Tuberk, 4: 35-38.

Guillet, D., 2004. Grain *Amaranthus*, History and Nutrition. Kokopelli Seed Foundation. http://www.kokopelli-seed-foundation.com/amaranths.htm (Accessed on 10/4/2006).

Gubitz, G.M., M. Mittelbach and M. Trabi, 1999. Exploitation of the tropical oil seed plant Jatropha curcas L. Bioresour. Technol., 67: 73-82.

Hilditch , T.P., 1949. The Industrial Chemistry of Fats and Waxes. 3rd Edn., Chapman and Hall, London: pp: 315-383.

Kalab, M. and T. Kerchler, 1997. The effect of the heptoprotective agent Liv – 52 on liver damage, Cas. Lek. Cesk, 136: 758-760.

Kapseu, C. and M. Parmentier, 1997. Fatty acid composition of some vegetable oils from Cameroon. Food Sci., 17: 325-31.

Kapseu, C., Y.J. Nono and M. Parmentier, 1999. Canarium schweinfurthii Engl.oil. olives of Sub-Saharan Africa. Rivista italiana delle Sostanze Grasse, 76(4): 181-183.

Kerharo, J., 1974. The Traditional Pharmacopeia Sénégalaise, Vigot Edn., pp: 419.

Lloyda, A.H. and Y. Youngk, 1999. Health benefits of docosahexaenoic acid (DHA). Pharmacol. Res., 40(3): 211-225.

Loi, A., P.S. Cocks, J.G. Howieson and J. Carr, 1997. Morphological Characterization of Mediterranean Populations of Biserrula pelecinus L. Plant Breed. 116: 171-176.

Morton, J.F., 1985. Indian almond (*Terminalia catappa*), salt-tolerant, useful, tropical tree with "nut" worthy of improvement. Econ. Bot., 39: 101-112.

Morton, J.F., 1991. The Horse radish tree, Moringa pterygosperma. A boon to arid lands? Econ. Botany, 45: 318-333.

National Research Council, 1974. Recommended daily dietary allowance. Nutritional Review 31(12): 373-395.

Nzikou, J.M., M. Mvoula-Tsieri, L. Matos, E. Matouba, A.C Ngakegni, M. Linder and S. Desobry, 2007. *Solanum Nigrum* L seeds as an alternative source of edible lipids and nutriment in Congo Brazzaville. J. Appl. Sci., 7: 1107-1115.

Oliveira J.S. and M.F. De Carvallo, 1975. Nutritional value of some edible leaves used in Mozambique. Econ. Bot., 29: 255.

Omoti, U. and P.A. Okyi, 1987. Caracteristics and composition of pulp and cake of the African pear Dacryodes edulis. J. Sci. Food Agri., 38: 67-72.

Onyeike, E.N., T. Olungwe and A.A. Uwakwe , 1995. Effect of heat treatment and defatting on the proximate composition of some Nigerian local soup thickeners. Food Chem., 53: 173-175.

Oyenuga, V.A., 1968.Nigeria's Foods and Feeding Stuffs. 2nd Edn., Ibadan University Press, Ibadan, Nigeria.

Pearson, D., 1976. The Chemical Analysis of Foods. 7nd Edn., ChurchillLivingstone, Edinburgh, U.K., pp: 422-511.

Pena, D.G., R.G.L. Anguiano and J.J.M Arredondo, 1992. Modification of the method 1 AOAC (CB-method) for the detection of aflatoxins, Bull. Environ. Contam. Toxicol., 49: 485-489.

Perry, M.C. and M.S. McIntosh, 1991. Geographical patterns of variation in the USDA soybean germplasm collection: I. Morphological Traits. Crop Sci., 31: 1350-1355.

Pomeranz, Y. and C. Meloan, 1994. Food Analysis: Theory and Practice, 3rd Edn., New York: Chapman and Hall. pp: 778.

Royo, C., C. Soler and I. Romagosa, 1995. Agronomical and morphological among winter and spring triticales. Plant Breed, 114: 413-416.

Rubatzky, V.E. and M. Yamaguchi, 1997. World Vegetables. Principles, Production and Nutritive Values. 2nd Edn., Inter. Thomson Publ., New York, pp: 681-686.

Sengupta, A. and M.P. Gupta, 1970. Studies on seed fat composition of Moringaceae family. Fette Seifen Anstrich, 72: 6-10.

Singh, S.P., J.A. Gutièrrez, A. Molina, C. Urrea and P. Gepts, 1991. Genetic Diversity in Cultivated Common Bean: II. Marker-Based Analysis of Morphological and Agronomic.

Somali, M.A., M.A. Bajneid and S.S. Al-Fhaimani, 1984. Chemical composition and characteristics of Moringa peregrine seeds and seeds oil. J. Am. Oil Chem. Soc., 61(1).

Souza E. and M.E. Sorrels, 1991. Relationships among 70 North American oat germplasm: I. Cluster analysis using quantitative characters. Crop Sci., 31: 599-605.

Tsaknis, J., S. Lalas, V. Gergis and V. Spiliotis, 1998. A total characterisation of Moringa oleifera Malawi seed oil. Riv. Ital. Sost. Gras., 75(1): 21-27.