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Physicochemical Characteristics and Fatty Acids from Dried and Boiled Seeds Oils of *Myrianthus arboreus* from Côte d'Ivoire

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Abstract: Seeds of *Myrianthus arboreus* P. Beauv were collected from from Didoko forest, at 140 km from Abidjan (Côte d'Ivoire)**.** One part of seeds (about 1 kg) was dried at sun (30-35°C) for a week (Dried Seeds, DS). A second part (1 kg), was boiled in water (100°C) for 30min (Boiled Seeds, BS). Oils were extracted using chloroform and methanol as solvent and the content in oil was determined by gravimetry. Physicochemical caractéristiques were determined using the méthodes of the American Oil Chemists Society. The total lipid contents of *myrianthus arboreus* seeds were 45.82±2.16 and 46.02±0.49; respectively for DS and BS. Physicochemical properties of these oils showed that acid values ; saponification and peroxide values and the iodine indices were 1,94±0.1 and 3,00±0.17 mg KOH/g ; 136,68 ± 0.32 mg KOH/g of oil and 148,36± 0.64 mg KOH/g of oil ; 5,49± 0.49 mEq/Kg and 5,6±0.10 mEq/Kg ; and 104,037±0.037 g I2/100g and 103.O42±0.042 g I2/100g respectively for DSO and BSO. The colours of *myrianthus arboreus* seeds oils were yellow-orange for DSO and pale yellow for BSO respectively. The quality and stability of traditionally processed *myrianthus arboreus* seeds oil as affected by temperature were evaluated by analyzing their physicochemical properties which included acid, saponification, peroxide, and iodine indices. The results indicate that All these parameters analysed increased except the iodine value witch decrease in the range of 4.037 to 2.02. The saponification value increases from 136,68 to 223.5, acid value from 1,94 to 10.75 and peroxide value from 5,49 to 14.48. Fatty acid profile of these oils revealed that the most abundant fatty acid in *myrianthus arboreus* seeds oils was linoleic.acid. In both oils, DSO showed the highest percentage of composition of 97,18 ± 0.18 and 88.95 ± 0.95 for BSO, respectively, followed close by with oleic acid (0,781±1.35 and 4,05±0.05 respectively for DSO and BSO) and linolenic acid (1,50 ±0.28 and 5,54±0.54 respectively for DSO and BSO).

Keywords: *myrianthus arboreus ;* seeds ; oils, boiled ; fatty acids ; dried ; charasteristics.

INTRODUCTION

Myrianthus arboreus P. Beauv (Cecropiaceae) called Bwamba in Eastern D.R. Congo, wunian ; atolahié or kenu-ikun in Côte d'Ivoire is a tree that grows to about 20 m high [1, 2]. It is a fruit plant, member of spontaneous food botanical species. In Africa, this plant covers mainly guineocongolaises regions spreading then of sierra leone to gabon [3]. Several ethnobotanic studies showed that *myrianthus arboreus* is a spontaneous food plant known in Côte d'Ivoire [4-6]. Fruits, seeds, barks, leaves and wood of *myrianthus a.* are variously used in several regions of Côte d'Ivoire but also by several populations of west and central Africa [7, 8]. The leaves of *myrianthus*, sold in several African markets are consume in sauce [9]. However, in spite of the nutritional importance of leaves revealed by several autheurs [10-12], Very few studies are carried out on fruits of *myrianthus* consumed dried or boiled. Moreover, Plant seeds are important sources of oils of nutritional, industrial and pharmaceutical importance [13]. The plant oils are traditional food products at high energy values. They are present in all biological tissues and are essential fatty acids (linoleic, linolenic and arachidonic acids) source. Since the suitability of oil for a particular purpose, however, is determined by its characteristics and fatty acid composition, the objective of this work is the determination of the physicochemical charasteristics and fatty acids of the oil of the seeds of fruits of *myrianthus arboreus* from Côte d'Ivoire.

MATERIALS AND METHODS

Collection and Preparation of Samples

Myrianthus arboreus fruit that served as sample for analysis were collected from Didoko forest, at 140 km from Abidjan (Côte d'Ivoire). Transported in the laboratory in bags in jutes and confined in tubs placed in an airy room among which the temperature and the relative humidity were respectively 27 °C and 82%. The fruits were transported the same day of their collection in plantations. The seeds were separated manually from flesh of the fruit. The seeds were washed with distilled water and one part (about 1 kg) was dried at sun (30-35°C) for a week (dried seeds, DS). A second part (1 kg), was boiled in water (100°C) for 30min (boiled seeds, BS). The seeds of all parts were then dried in the steam room ventilated at 55°C during 48 hours. These seeds were ground into flours using Moulinex blender. The different flours DS and BS were stored in polythene bags and kept in refrigerator at 4°C until used for analysis.

Extraction of oil

The oils of different flours (DS and BS) of *myrianthus arboreus* fruits seeds were extracted According to Folchet *et al.* method. [14] modified by Christie [15] using chloroform and methanol as solvent and the content in oil was determined by gravimetry.

Physicochemical characteristics determination

For the determination of physicochemical characteristics of DS and BS oils extracted from *myrianthus arboreus* seeds of fruits, several methods have been used: moisture was determined with pH method [16], index refractive with Multisecale Automatic Refractometer, the color was measured with a colorimeter. Acid value, ester value, peroxide value, iodine value and saponification values were determined by AOAC [17] method. All analyses were performed in triplicate.

Fatty Acid Composition Analysis

Fatty acid methyl esters (FAME) were obtained by transmethylation of lipid aliquots (100 mg) according to European Pharmacopoeia 2008: samples were dissolved with 1.5 mL of hexane and 1.5 mL of boron-trifluoride in methanol (14%, w/v), and heated at 100°C under nitrogen for 1 h. After cooling, the fatty acid methyl esters were extracted in hexane under nitrogen; equipped with a flame ionization detector (FID) and fused capillary column HP-5 (Cross-Linked 5 % PH ME Siloxane) length 30 m; film thick 0.25 µm; 0.32 mm intern diameter; 5 % of biphenyl; 95 % dimethyl polysiloxane; no polar, with a programming of oven temperature is croissant de 60 at 325 °C at the rate of 1°C /min. Both the injector and the detector were maintained at 275 °C and 325 ºC, respectively Nitrogen was used as the carrier gas at 1cm/min with a time-out is 1 min 15 s (hydrogen 40 cm /s).

Fatty acids were identified by comparing their retention times with those of standard compounds (palmitic; miristic, lauric, linolenic; linoleic; oleic; stearic acids …)

Statistical Analysis

The analyses were carried out in triplicate and data were expressed as mean ± standard deviation. Analysis of variance (ANOVA) followed by Newman Keels range test to show, at the level of 5 %, was used to compare means followed by standard deviation (STATISTICA 7.1 software)

RESULTS AND DISCUSSION

Fats contents

The total lipid contents of *myrianthus arboreus* seeds (Table 1) were 45.82±2.16 and 46.02±0.49; respectively for DS and BS. These results, showed that *myrianthus arboreus* seeds could be considered as good lipid source. These values were comparable to those of certain edible oils [peanut (45-50%), palm kernel (48%)] [18] and to the one of nonconventional oil *Canariium schweinfurthii* Engl. (45%) [19]. Lower than those reported by Kazadi Minzangi *et al*., [20], for R.D. Congo *M. arboreus* seed oil (52.38 ± 1.21 %), by Essien and Eduok [21] for southern Nigeria *Citrullus lanatus* seed oil (57.26 %), Fokou *et al*. [22], for Cucurbitaceae oils from four different regions in Cameroon, (49.01- 52.15g/100g), but higher in value than for R.D. Congo *M. holstii* oil, (35.16 ± 0.90), breviflora seed oil (22.9%) [23] or *Lagenaria siceraria* (Mol.) cultivars from Nigeria (38.10-43.65%) [24].

Physicochemical charasteristics

The acid value represents free fatty acid content due to enzymatic activity. The acid values were 1,94±0.1 and 3,00±0.17 mg KOH/g for DSO and BSO respectively (Table 1). Similar to oil acidity value from *T. africana* in samples from Nigeria, Dawodu [25] has reported the oil acid value of 1.96. Theses values were below 5.00% free fatty acids content recommended as the maximum for non-rancid oil [26, 27]. This implies that the studied oils were not rancid. Then, Oil that is low in acidity is suitable for consumption [28]. The acid value is low, acid value of 0.00 to 3.00 mg KOH/g oil is recommended for oil to find application in cooking [29]. Thus the oil from *myrianthus arboreus* seeds could be suitable for cooking.

Saponification value is an index of average molecular mass of fatty acids in oil sample. The higher saponification values 136,68 ± 0.32 mg KOH/g of oil (DSO) and 148,36± 0.64 mg KOH/g of oil (BSO) respectively in the *myrianthus arboreus* seeds oil suggest that the mean molecular weight of fatty acids is higher. This might imply that the fat molecules were intact. High saponification value indicated the presence of greater number of ester bonds, suggesting that the fat molecules were intact. These properties make it useful in soap making industry [30]. These values were also

lower than those of non-conventional oils such as *Dacryodes elulis*, the African pear (201.4 mg KOH/g of oil) [31], *Coula edulis* (180-185 mg KOH/g of oil) [32], C. schweinfurthii (177-197.79 mg KOH/g of oil) [33].

The peroxide value is used as an indicator of deterioration of oils, thus low peroxide value indicates resistance of the oil to peroxidation during storage. Fresh oils have peroxide values lower than 10 meq O2/kg and before oil becomes rancid, its peroxide value must be between 20 and 40 meq O2/kg [34]. The peroxide value of oils from *myrianthus arboreus* seeds obtained in this work were low (5,49± 0.49 mEq/Kg and 5,6±0.10 mEq/Kg) compared to the maximum acceptable value of 10 meq KOH/g set by the Codex Alimentarius Commission for groundnut seed oils [35]. These oils were thus stable and would not easily go rancid. Peroxide formation is an indication that lipid oxidation is on-going, these compound react with low molecular weight metals to produce free radicals that are capable of further lipid oxidation [36].

The iodine indices obtained in this study for the studied oils were 104,037±0.037 g I2/100g and 103.O42±0.042 g I2/100g respectively for DSO and BSO respectively. The iodine value is a measure of the degree of unsaturation in oil and could be used to quantify the amount of double bonds present in the oil which reflects the susceptibility of oil to oxidation. Lipids with unsaturated fatty acids (containing one or more double bonds) are easily assimilated and broken down to produce calorific energy than saturated fatty acids. However, when the iodine value becomes too high, the stability of the oil reduces because it is more likely to undergo oxidation. These iodine values of DS and BS oils, were similar to those of unsaturated fatty acid rich oils such as peanut (86.06-107.0 g I2/100g), cotton seed (100.0- 123.0 g I2/100g), but lower than that of sunflower (118.0-141.0 g I2/100g), of soybean oil (124.0- 139.0 g I2/100g) [37]. However, *myrianthus arboreus* seeds oils had higher iodine values than those of saturated fatty acid-rich oils such as Theobroma cacao, cocoa butter (32.0-42.0 g I2/100g) [38], coconut (6.0- 10.0 g I2/100g), palm oil (50.0-55.0 g I2/100g), palm kernel (14.0-1.0 g I2/100g) [37].

The colour of the oil is used preliminarily in judging the quality and in determining the degree of bleaching of the oil. For Powe [39], the darkerthe colour, the poorer the quality. Therefore the yellow-orange (DSO) and pale yellow (BSO) colours of *myrianthus arboreus* seeds oils shows that the quality of these oils is good and confirms to Encyclopedia of Chemical Technology [39, 40].

Table-1: Fats and physicochemical properties of *myrianthus arboreus* seeds oils

	Dried seed oil (DSO)	Boiled seed oil (BS0)
Peroxyde index (meq O2/kg)	5.49± 0.49[a]	5,6± 0.1[a]
saponification index(mg KOH/g)	136,68± 0.32[a]	148,36± 0.64[b]
acid index (mg KOH/g)	1,94± 0.24[a]	3± 0.5[b]
Iodine index (mg Iodine / 100 g)	104,0.37± 0.037[a]	103,042± 0.032[b]
pH	4,14± 0.14[a]	4,16± 0.16[a]
Acidity	26,51± 0.51[a]	28,93± 0.43[b]
Lipid (%)	45.82±2.16[a]	46.02±0.49[b]
Color	Yellow- orange	Pale-Yellow

Effects of temperature on the physicochemical properties of *myrianthus arboreus* seeds oils

The quality and stability of traditionally processed *myrianthus arboreus* seeds oil as affected by temperature were evaluated by analyzing their physicochemical properties which included acid, saponification, peroxide, and iodine indices (Table 2). The results indicate that All these parameters analysed increased except the iodine value witch decrease in the range of 104,0.37± 0.037 to 70,02± 0.37. The saponification value increases from 136,68± 0.32 to 223,5± 0.05, acid value from 1,94± 0.24 to 10,75± 0.14 and peroxide value from 5.49± 0.49 to 14,48± 0.32.

The decrease of iodine value at elevated temperature could be attributed to destruction of double bonds in the oils upon heating. This could be due to the effect of high temperature causing destruction of π-bonds and hence decreasing the degree of unsaturation. The high decreased iodine value of *myrianthus arboreus* seeds oil could be due to the predominance of unsaturated fatty acids (PUFA) as linoleic acid.

The results show an increase in the saponification value **(**136,68± 0.32 mg KOH g–1 oil to 223.5± 0.05 mg KOH g–1 oil), during heating at temperatures from 30°C to 150°C. High saponification value indicates that oils are very useful in production of liquid soap and shampoo industries. Therefore, these values obtained from *myrianthus arboreus* seeds oil shows that it has high potential for use in the production of liquid soap and shampoos [41]. The saponification value gives an idea about the number of ester equivalents per unit mass of the oil or biodiesel.

The increase in the peroxid index (5.49± 0.49 mequiv O2/kg oil to 14.48± 0.32 mequiv O2/kg oil) indicates that this oil was unstable to oxidative degradation. Choo *et al*. [42] reported that there were increases in PV and *p*-AnV of flaxseed oil during pan-

heating. According to the Codex Alimentarius Commission [43] standard for virgin oils and cold pressed fats and oils, good quality oil should have a peroxide value of less than 10 milliequivalents peroxide/kg of oil. The results of peroxide values of flaxseed hull oil after heating agree with Choo *et al*. [42] who reported that there were an accumulation of peroxides during heating.

According to the Codex Alimentarius Commission standard [43], the acid values of *myrianthus arboreus* seeds oil were not still within the limits for virgin oils and cold pressed fats and oils. These results indicate that heating of *myrianthus arboreus* seeds oils at high temperatures cause much formation of free fatty acids due to oxidation or heat induced hydrolysis.

Table-2: Effects of temperature on the physicochemical properties of *Myrianthus arboreus* seeds oil

	30^0C	60^OC	90^OC	120^OC	150^OC
Peroxyde index (meq O2/kg)	5.49± 0.49	8,8± 0.25	10,48± 0.19	11,65± 0.14	14,48± 0.32
saponification index (mg KOH/g)	136,68± 0.32	143,2± 0.71	172± 0.23	183,94± 0.14	223,5± 0.05
acid index (mg KOH/g)	1,94± 0.24	2± 0.51	4,8± 0.09	7,44± 0.11	10,75± 0.14
Iodine index (mg Iodine / 100 g)	104,0.37± 0.037	93,069± 0.25	88,947± 0.44	85,417± 0.22	70,02± 0.37
pH	4,14± 0.14	4,16± 0.04	4,2± 0.31	4,2± 0.12	4,2± 0.42

Fatty acids composition

This study revealed that the most abundant fatty acid in *myrianthus arboreus* seeds oils was linoleic.acid. In both oils, DSO showed the highest percentage of composition of 97,18 ± 0.18 and 88.95 ± 0.95 for BSO, respectively, followed close by with oleic acid (0,781±1.35 and 4,05±0.05 respectively for DSO and BSO) and linolenic acid (1,50 ±0.28 and 5,54±0.54 respectively for DSO and BSO). Variances analysis showed that there was significant difference ($p<0.05$) in these differents type of fatty acids(Table 3).

These results, showed that *M. arboreus* oil is particularly rich in linoleic acid (C 18:2).witch is important essential fatty acid required for growth, physiological functions and body maintenance [44]. Furthermore, Linoleic acid is one of the most important polyunsaturated fatty acids in human food because of its prevention of distinct heart and vascular diseases. Apart from preventing cardiovascular disorders such as coronary heart diseases and atherosclerosis; linoleic acid prevents high blood pressure. Also linoleic derivatives serve as structural components of the plasma membrane and as precursors of some metabolic regulatory compounds [45]. In addition, they are often used in food industries to provide texture and softness to products [46]. Indeed, linoleic acid plays an important role in the ceramides synthesis. It is known that acetylceramides, including linoleic acid is one of its main components, play a leading role in the lipid barrier formation of the skin.

As can be seen in Table 3, *myrianthus arboreus* seeds oils unsaturated fatty acids have great importance because of their nutritional implication and effect on the oxidative stability oils. These oils high in UFA have been well documented to provide numerous health benefits [47, 48]. Unsaturated fatty acids values of *myrianthus arboreus* seeds oils from Cote d'Ivoire suggest that they could be some goods sources of edibles oils (for cooking) and a potential antidote for fight against cardiovascular disease. These results revealed that ivorian's *myrianthus arboreus* seeds oils were in agreement with all other studies of Cucurbitaceae seeds oils which were low in linolenic acid (<1%) [49, 50].

The high percentage of polyunsaturated fatty acids in the oils from *myrianthus arboreus* seeds were supported by the high iodine value obtained for the oil in this study. The abundances of unsaturated fatty acids in the oils were desirable from the nutritional and health view points as unsaturated fatty acids consumption will not lead to heart related diseases while the consumption of foods rich in saturated fatty acids is implicated with certain cardiovascular disorders like atherosclerosis, cancer and aging [51, 52].

Table-3: Fatty acids composition (% GC area) of *myrianthus arboreus* seeds oils

	Graines séchées	Graines bouillies
Acide linoléique	97,18± 0.18[a]	88,95± 0.85[b]
Acide oléique	0,781± 0.35[a]	4,05± 0.05[b]
Acide linolénique	1,50± 0.28[a]	5,54± 0.54[b]

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