

**INTERNATIONAL JOURNAL OF FOOD AND
NUTRITIONAL SCIENCES**

IMPACT FACTOR ~ 1.021



Official Journal of IIFANS

OIL FROM *OZOROA INSIGNIS* DEL FRUITS: TOWARD A NEW SOURCE OF NATURAL OIL

Lassina Ouattara^{1*}, Paulin Ouoba², Philippe Pierre Robichaud³, Jérémie A Doiron³
and Marc E Surette³

*Corresponding Author: Lassina Ouattara, ✉ lasouatt@yahoo.fr

Received on: 15th June, 2017

Accepted on: 25th October, 2017

This study examined the oleaginous potential of fruits of *Ozoroa insignis* Del., a plant located in the western part of Burkina Faso. The extraction of the oil was done by the soxhlet method using petroleum ether as solvent. An average oil yield of $27.2 \pm 2.3\%$ was obtained, mainly from the mesocarp of the fruit. The fatty acid composition was determined by gas chromatography. This oil contains six saturated fatty acids and six unsaturated fatty acids at different concentrations. In terms of proportion, this oil contained monounsaturated fatty acids (58.5%), polyunsaturated fatty acids (17.1%) and saturated fatty acids (24.4%). This oil mainly contains oleic acid (32.9%), palmitic acid (16:0) (19.3%), linoleic acid (18:2) (16.1%) and vaccenic acid (18:1-n-7) (23.6%). With regard to essential fatty acids, in addition to linoleic acid, this oil also contained small quantities of the omega-3 alpha-linolenic acid (18:3-n-3) (1.0%). No earlier study mentioned this plant as an oleaginous species. The composition in fatty acids of this oil suggests that it could be used in the diet and cosmetics after further study such as the profile of glycerides and vitamins or dyes and its safety.

Keywords: *Ozoroa insignis* Del, Fatty acid, Bobo-Dioulasso, Burkina faso

INTRODUCTION

Many oilseed plants in sub-Saharan Africa are used in food, pharmaceutical and cosmetic industries (Arbonnier, 2002; and Leray, 2010). However, many other species found in Africa's natural vegetations are still under-exploited and even unrecognized by populations (Ouoba, 2006). This is the case of *Ozoroa insignis* Del. of which no earlier study mentioned its oleaginous potential.

This species belongs to the family *Anacardiaceae*. It is a small tree up to 3 to 5 m in height, but more commonly encountered as a shrub up to 1 to 2 m in height. The fruits are flattened drupes, shining and black at maturity, 5 to 8

mm wide, 5 to 6 mm high (Berhaut, 1972). The ripe fruits are available from November to March. The species is quite common in the Sudano-Guinean area. Its geographical area extends from Senegal to South Africa (Berhaut, 1972). The roots are traditionally used as a medicinal treatment against worms and ulcers, and leafy branches are used against high blood pressure (Berhaut, 1972; and Malgras, 1992). The use of the fruits is not mentioned in the literature. In South Africa, fruits are crushed and used by Zulu women to perfume their hair (Oyen, 2007).

The aim of this work is to assess whether or not the mesocarp of *Ozoroa insignis* fruits are potential source of

¹ Université Polytechnique de Bobo-Dioulasso, Unité de Formation et de Recherche en Sciences et Techniques (UFR-ST), Département de Génie-Biologique.01, BP 1091 Bobo-Dioulasso 01, Burkina Faso.

² Université Polytechnique de Bobo-Dioulasso, Unité de Formation et de Recherche en Sciences et Techniques (UFR-ST), Département de Sciences Biologiques.01, BP 1091 Bobo-Dioulasso 01, Burkina Faso.

³ Université de Moncton, Département de Chimie et Biochimie, Moncton, NB, E1A 3E9 Canada.

in oil and to analyze the profile of the fatty acids. This work is part of the characterization and valorization effort of plant resources around Bobo-Dioulasso city, whose flora is very rich in plants that are not well known from a chemical point of view.

MATERIALS AND METHODS

Plant Material

Our work has focused on the dried fruits of *Ozoroa insignis Del* harvested at *Dindérosso* (Itm:30p: X = 0347000; Y = 1241500), *Kua* (itm:30p: X = 367237; Y = 1233166) and *Darsalamy* (Itm:30p: X = 0349155; Y = 1219060), three places around the city of Bobo-Dioulasso. In this area *the* flowering of this species begins in September and ripe fruits are available from December to March (Figure 1).

Fruits Dampling

The fruits were harvested during the months of December and January. From 200 to 500 g of fruit were taken per

individual depending on the availability of the fruit. In the Plant Biology Laboratory the fruits were dried away from light for at least two weeks.

Extraction of Crude Oil from *Ozoroa insignis Del Fruits*

After drying the fruits away from light, they were crushed with a GM-200 Retsch grinder. The crushed products obtained were used for the extraction of lipids. The extraction was carried out using a soxhlet type extractor according to the standard NF EN ISO 659,2009. For this purpose the cartridges (HM1004-33x94 mm) were filled with 200g of crushed fruits and placed in the column of the extractor. Petroleum ether (CARLO ERBAREAGENT-SDS) was used for extraction. After 4 hours, the extract (mixture of solvent and fat) was subjected to rotary evaporation (BUCHI ROTAVAPOR R-200) to remove the solvent. The experiment was repeated three times. The crude oil was recovered and the average yield of the extraction calculated according to

Figure 1: Ripe Fruits of *Ozoroa insignis Del*



the following formula: $(m/M) \times 100$; with m the mass of oil and M the mass of fruits. The oil obtained was stored at 4 °C before analyzing the profile of fatty acids by gas chromatography.

Analysis of the Fatty Acids Profile

The crude oil obtained by sohxlet extraction was analyzed by gas chromatography after derivatization (Surette *et al.*, 2003). The method can be described as follows: a mixture of 2 ml of methanol, 0.9 ml of chloroform, 20 ml of acetic acid, 800 µl of milliQ H₂O, 20 µl of the crude oil of *Ozoroa insignis* and 100 ml of internal standard (Hexadecanoic acid:C17:0) were mixed. After 15 min incubation at room temperature, 2 ml of chloroform and 1 ml of milliQ H₂O were added to the mixture. The tubes were gently inverted twice and centrifuged for 5 min at 1000 RPM to separate the two phases. The lower phase (chloroform) was transferred to a new glass tube and a second extraction was made on the first tube with 2 ml of chloroform and the two lower phases combined. The lipids were dried and hydrolyzed with 400 ml of KOH (0.5 M) at 100 °C for 15 min. The fatty acids were then transmethylated with 1 ml of 14% boron trifluoride at 100 °C for 10 min. The resulting Fatty Acid Methyl Esters (FAMES) were then extracted by partitioning between 2 ml of hexane and 1.6 ml of HCl (0.125 M).

The hexane extract was transferred to a GC vial and analyzed by gas chromatography using a Thermo Trace gas chromatograph (Thermo Electron Corporation, Mississauga, ON, Canada). The volume injected was 1 ml. The injection was made in split mode 1/40 onto a Trace-FAME column (Thermo) with flame ionization type detector. The fatty acids were identified by comparing their retention times with those of authentic standards, and a standard curve was used for quantification (Surette *et al.*, 2003). All analyses were performed in triplicate.

Data Analysis

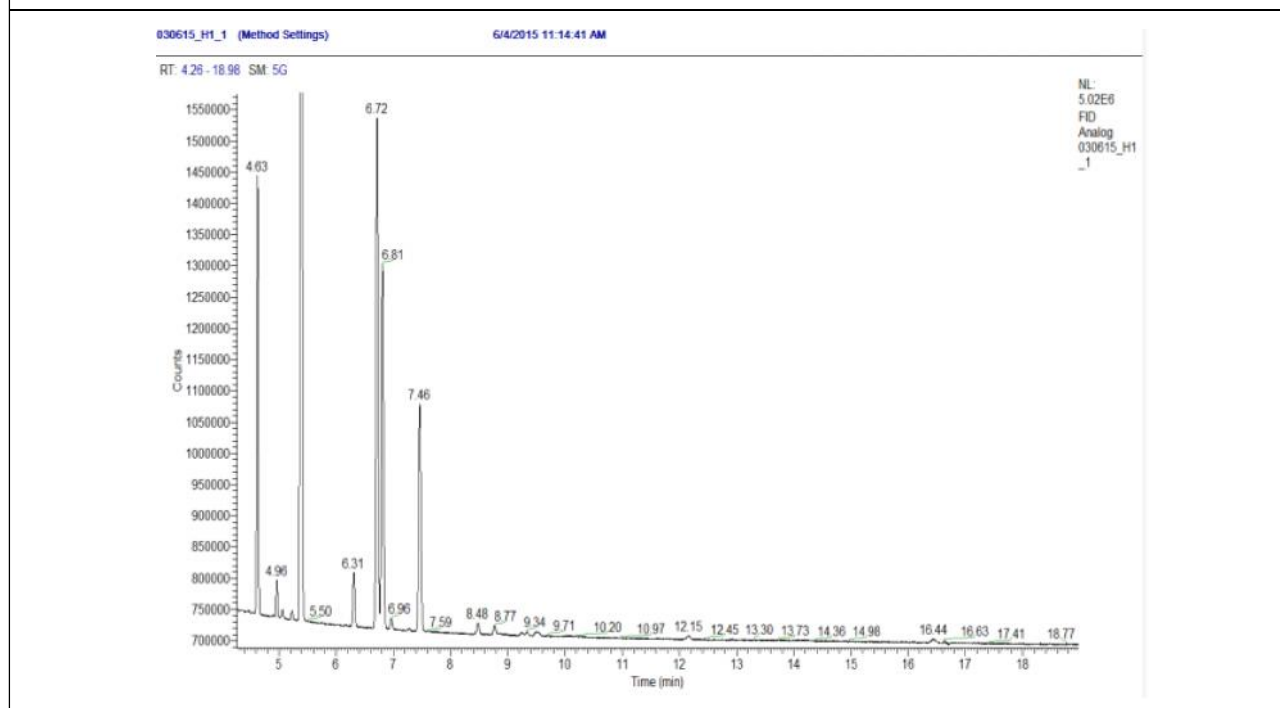
Microsoft Excel was used as data analysis software. The oil extraction yields and percentages of fatty acids are expressed as mean plus or minus standard deviation values.

RESULTS

Extracting Yield

After three separate extractions, we obtained an average oil yield of $27.2 \pm 2.3\%$. In the *Ozoroa insignis* species, the seeds are not oleaginous; the oil is located in the mesocarp of the fruit. This oil extracted from the mesocarp is of black-violet color. This yield is quite high compared to that of several commercially-produced oilseeds.

Figure 2: Chromatogram of *Ozoroa insignis* Fruits Oil Giving Retention Time and Relative Abundance of Fatty Acids and Internal Standard (17:0, RT:5.50 min)



Profile of Fatty Acids

Figure 2 shows the chromatogram of the derivatized oil, peaks representing fatty acids present in the extracted oil. The integration of these peaks allowed us to determine the relative abundance of each fatty acid; which made it possible

to determine the percentage of each of these fatty acid in relation to the total of the fatty acids.

Table 1 shows the result of the analysis of the fatty acid profile of *Ozoroa insignis* crude oil. A total of twelve fatty acids, six saturated fatty acids and six unsaturated

Table 1: Fatty Acids of *Ozoroa insignis* Fruits Oil

Fatty Acides		Percentage of Total Means \pm SD	Retention Time (min)
14:00	Myristic acid acid	0.19 \pm 0.01	3.51
14:01	Myristoleic acid acid	ND	
16:00	Palmitic acid	19.3 \pm 3.1	4.63
16:01	Palmitoleic acid	1.7 \pm 0.3	4.96
18:00	Stearic acid	3.2 \pm 0.6	6.31
18:1 n-9	Oleic acid	32.9 \pm 5.4	6.72
18:1 n-7	Vaccenic acid	23.6 \pm 3.8	6.81
18:02	Linoleic acid	16.1 \pm 2.6	7.46
18:3 n-6	Gamma-linolenic acid	ND	
18:3 n-3	Alpha-linolenic acid	1.0 \pm 0.2	8.48
20:00	Arachidic acid	0.7 \pm 0.1	8.77
18:4 n-3	Stearidonic acid	ND	
20:01	11-eicosenoic acid	0.4 \pm 0.04	9.34
20:2 n-6	11,14-eicosadienoic acid	ND	
20:3 n-6	dihomo- γ -linolenic acid	ND	
20:4_n-6	Arachidonic acid	ND	
20:3 n-3	11,14,17-eicosatrienoic acid	ND	
22:00	Behenic acid	0.4 \pm 0.1	12.15
22:01	Erucic acid	ND	
20:5 n-3	Eicosapentaenoic acid	ND	
22:04	Docosatetraenoic acid	ND	
24:00:00	Lignoceric acid	0.6 \pm 0.1	16.43
24:01:00	Nervonic acid	ND	
22:05	Docosapentaenoic acid	ND	
22:06	Docosahexaenoic acid	ND	

Note: SD = Standard Deviation; ND = Not detected.

fatty acids, were found at different concentrations. However, in terms of proportion, this oil is more concentrated in unsaturated fatty acids (75.6%) than in saturated fatty acids (24.4%), which mainly contains the following compounds: oleic acid (18:1-n-9) (32.9 %), palmitic acid (16:0) (19.3%), linoleic acid (18:2) (16.1%) and vaccenic acid (18:1-n-7) (23.6%). In addition, fatty acids in low proportions in descending order are: stearic acid (18:0), palmitoleic acid (16:1), alpha-linolenic acid (18:3-n-3), arachidic acid (20:0), lignoceric acid (24:0), behenic acid (22:0) and eicosanoic acid (20:1). Two essential fatty acids, namely linoleic acid (w6) in larger amounts and linolenic acid (w3) in lower amounts were measured noted in this oil. Monounsaturated fatty acids account for 58.53% of the total fatty acids versus 17.1% for polyunsaturated fatty acids.

DISCUSSION

Taking into account the extraction yield ($27.2 \pm 2.3\%$) of *Ozoroa insignis* fruits oil we can say that it has an interesting oil potential since this yield is high compared to that of several oilseeds. For example, cotton and soybean seeds contain 15-25% and 15-22% of oil, respectively (Ribier and Rouzière, 1995).

The analysis of the fatty acids by gas chromatography allowed us to detect a total of twelve fatty acids, six of which were saturated and the other six are unsaturated. However, in terms of proportion, this oil is more concentrated in unsaturated fatty acids with monounsaturated fatty acids accounting for 58.5% of the total fatty acid versus 17.1% for polyunsaturated fatty acids, with saturated fatty acids accounting for (24.4%) of the total. The mean relative abundance of the main fatty acid measured were oleic acid ($32.9 \pm 5.4\%$), palmitic acid ($19.3 \pm 3.1\%$), linoleic acid ($16.1 \pm 2.6\%$) and vaccenic acid ($23.6 \pm 3.7\%$). In addition, the more minor fatty acids detected were stearic acid, palmitoleic acid, alpha-linolenic acid, arachidic acid, lignoceric acid, behenic acid and eicosanoic acid which ranged from 3.2% to 0.4% of total fatty acids. Two essential fatty acids were measured, namely linoleic acid (w6) in large quantities and alpha-linolenic acid (w3) which was a minor fatty acid accounting for 1% of the total.

The ratio of polyunsaturated fatty acids to saturated fatty acids was 0.7 which is considered by some authors as ideal for an edible oil (Fossati, 2000). The omega 6/omega 3 fatty acid ratio was 16.4. According to Lambert (2005), the omega 6/omega 3 fatty acid ratio desired for a

dietary oil is 5, thus the omega 6/omega 3 ratio of oil from *Ozoroa insignis* fruit is closer to this value compared to that of several edible oils consumed in Burkina Faso and Africa such as cotton oils (omega 6/omega 3 = 567) and groundnut (omega 6/omega 3 = 333) (Lambert, 2005). Until now, no study has mentioned the existence of this oil, but according to Arbonnier (2002), the fruits of this species are consumed by children. The composition in fatty acids of this oil suggests that it could be used in the diet after further study to characterize parameters such as the profile of glycerides, vitamins or dyes as well as its safety profile.

Moreover, this oil could be exploited in cosmetics for the beneficial effects that it could have on the skin. It contains two the essential fatty acids, linoleic acid (w6) and linolenic acid (w3), which according to Abdou Bouba (2009), are known as vitamin F and can afford protection of the skin. This so-called vitamin F is incorporated to about 5% in some dermatological creams.

One of the special features of this oil is that it contains a significant proportion of vaccenic acid, an isomer of oleic acid (w9) which is generally found in animal fats and dairy products (Mozaffarian *et al.*, 2006; and Field *et al.*, 2009). According to some authors, unlike industrial trans fatty acids, vaccenic acid would have a beneficial effect on human health (Field *et al.*, 2009).

CONCLUSION AND PERSPECTIVES

This prospective study allowed us to show the oleaginous character of fruits of *Ozoroa insignis* and to establish the fatty acid profiles of the crude oil. One of the features of this crude oil is that it contains a high proportion of unsaturated fatty acids with the presence of two essential fatty acids, as linoleic acid and linolenic acid, which are not synthesized by animals and human. The next step of the study of this oil as a product for use in humans would be to characterize the profile of glycerides, vitamins and dyes likely to be present in this oil. It would be also necessary to assess its safety. This would allow us to take stock of the nutritional potential of this oil that is obtained in significant quantities from the fruit of this common plant.

ACKNOWLEDGMENT

Department of Chemistry and Biochemistry, University of Moncton (CANADA), Marc E. Surette is supported by a New Brunswick Innovation Research Chair.

REFERENCES

- Abdou Bouba A (2009), “Contribution à l’étude du développement d’un aliment fonctionnel à base d’épices du Cameroun: Caractérisation physico-chimique et fonctionnelle, Thèse de Doctorat de l’Université de Ngaoundéré”, Cameroun.
- Arbonnier M (2002), “Arbres, arbustes et lianes des zones sèches d’Afrique de l’Ouest”, *Cirad-mnhn-uicn*.
- Berhaut J (1971), “Flore illustrée du Sénégal. Ministère du Développement Rural et de l’Hydraulique”, Direction des Eaux et Forêts.
- Field C J, Blewett H H, Proctor S and Vine D (2009), “Human Health Benefits of Vaccenic Acid”, *Appl Physiol Nutr Metab.*, Vol. 34, No. 5, pp. 979-991.
- Fossati P (2000), “Bases nutritionnelles de l’alimentation lipidique normale”, *Thérapie*, Vol. 51, pp. 615- 621.
- Lambert J (2005), “Les huiles végétales: 2000 plantes oléagineuses”, Institut Français des huiles végétales pures [cited January 29, 2016], available from: <http://institut.hvp.free.fr/>
- Leray C (2010), “Les lipides dans le monde vivant: introduction à la lipidomie”, *Edition Lavoisier*.
- Malgras D (1992), “Arbres arbustes guérisseurs des savanes maliennes Karthala et ACCT”, Paris.
- Mozaffarian D, Katan M B, Ascherio A, Stampfer M J and Willett W C (2006), “Trans Fatty Acids and Cardiovascular Disease”, *N Engl J Med.*, Vol. 354, pp. 1601-1613.
- Ouoba P, Boussim I and Guinko S (2006), “Le potentiel fruitier de la Forêt Classée de Niangoloko”, *Fruits*, Vol. 61, No. 1, pp. 71-81.
- Oyen L P A (2007), “*Ozoroa insignis* Del. Resources végétales de l’Afrique tropicale. PROTA Network Office Europe”, Wageningen University Wageningen, Netherlands [cited April 25, 2016] available from: [http://uses.plantnet-project.org/fr/Ozoroa_insignis_\(PROTA\)/](http://uses.plantnet-project.org/fr/Ozoroa_insignis_(PROTA)/)
- Ribier D and Rouzière A (1995), “La transformation artisanale des plantes à huile: expériences et procédés”, GRET, Paris.
- Surette M E, Koumenis I L, Edens M B, Trampusch K M and Chilton F H (2003), “Inhibition of Leukotriene Synthesis: Pharmacokinetics and Tolerability of a Novel Dietary Fatty Acid Formulation in Healthy Adult Subjects”, *Clin Ther.*, Vol. 25, pp. 948-971.

