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Fatty Acid and Triglyceride Composition of the Oil from the Almonds of *Pentaclethra macrophylla Benth.*, Collected at Ontogo in the Republic of the Congo

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Abstract

Pentaclethra macrophylla Benth., also known as "Paayi" in the collection area, is an underutilised oil-bearing non-timber forest product from the Congo Basin. This study evaluated the fatty acid profile and triglyceride composition of seed kernel oil collected in Ontogo, in the sub-prefecture of Boundji, Cuvette Department. Oil extracted via Soxhlet (hexane) was transmethylated with boron trifluoride (BF_3) and analyzed by gas chromatography (GC-FID). A probabilistic model based on the (1,2,3-random) distribution predicted triglyceride species, compared against experimental data (C50 to C62). Results show an oil rich in polyunsaturated fatty acids (43.89 ± 3.50%), dominated by linoleic acid (43.77 ± 3.50%) and oleic acid (24.33 ± 1.95%). Remarkably, the saturated fraction (30.03 ± 2.40%) is exceptionally rich in very long-chain fatty acids (VLCFAs: 23.6 ± 1.9%), notably lignoceric (11.57 ± 0.93%), behenic (6.62 ± 0.53%), cerotic (2.81 ± 0.50%), and arachidic (2.60 ± 0.50%) acids. Triglycerides were dominated by C54 (35.26 ± 2.82%), C60 (23.53 ± 1.88%), C58 (18.62 ± 1.49%), and C56 (12.49 ± 1.00%). The probabilistic model identified major species—*LLO* (13.98 ± 1.12%), *LLL* (8.39 ± 0.67%), and *LOO* (7.77 ± 0.62%)—and rare VLCFA-containing triglycerides including *LOLi* (7.39 ± 0.59%) and LLLi (6.65 ± 0.53%). This atypical composition categorises *P. macrophylla* oil as a linoleic-VLCFA structured fat, serving as a promising alternative to synthetic ceramides for cosmetics (barrier repair) and nutraceuticals.

Keywords

PFNL, Oil, Fatty Acids, Triglycerides, Probabilistic Approach

1. Introduction

Vegetable oils are a major source of lipids and functional ingredients. Their technological and nutritional value depends closely on their fatty acid composition and the structure of their triglycerides (TGs). In Central African countries, including the Republic of the Congo, the exploration of underutilised local forest resources is crucial for diversifying sources of fats and meeting the needs of the agri-food and cosmetics industries.

The Congo Basin forest is rich in Non-Timber Forest Products (NTFPs) with remarkable properties. Among these, *P. macrophylla* (known as "paayi" in the Congo and "ugba" in Nigeria), an endemic oilseed legume, occupies a prominent place. Whilst traditional tropical oilseeds such as olive and argan are well documented and recognised as being relatively balanced, *P. macrophylla* has an atypical lipid profile consisting of a significant proportion of very long-chain fatty acids (VLCFAs, C20 to C26) [1]. This structural characteristic alters the oil's rheological, thermal and metabolic properties, potentially bringing it closer to structured vegetable butters such as mowrah butter, which is produced from *Madhuca latifolia* [2].

However, wild-growing strains in the Republic of the Congo, particularly those in the Cuvette department, have been the subject of only very few biochemical investigations. There is a particularly significant lack of data regarding the detailed structure of its triglycerides.

Against this background, the aim of this study is to characterise the fatty acid composition of *P. macrophylla* oil collected in Ontogo.

In an innovative approach, this study combines an experimental determination of the major triglyceride families, based on carbon atom count, with a probabilistic mathematical approach to identify and quantify the major species. This approach aims to provide evidence to support the industrial development of this Congolese resource.

2. Materials and Methods

2.1. Plant Material

To ensure the representativeness of the local ecotype of Pentaclethra macrophylla Benth., mature fruits were randomly harvested from five different trees located in Ontogo, in the sub-prefecture of Boundji, in the Cuvette department, in the Republic of the Congo. The botanical identity of the plant was confirmed at the National Herbarium of the Congo (Brazzaville). To eliminate inter-tree genetic variability, the seeds from these different batches were carefully mixed to form a sin-

gle, homogeneous composite sample (pool) from which independent analyses were performed. Once transported to the laboratory, they were shelled, oven-dried for 120 hours until their mass stabilised, and then finely ground. The resulting ground material, which was semi-solid and partially pasty in appearance, served as the raw material for oil extraction.

2.2. Oil Extraction

Fat extraction was carried out continuously using the Soxhlet method [3]. Thirty grams (30 g) of ground almonds were placed in a cellulose cartridge, which was inserted into the extractor. The flask, containing 200 mL of hexane, was placed in the apparatus and then heated under reflux for 3 hours. The extract obtained, which contained traces of hexane, was placed in an oven for desolvation. The resulting product had a bright yellow colour after desolvation. A change in colour to dark yellow was observed following prolonged exposure to heat.

The oil was analysed at the laboratory of the Technical Institute for the Study and Research of Fats (ITERG) in France in March 2026 to determine its fatty acid profile.

2.3. Determination of the Fatty Acid Profile

2.3.1. Preparation of Methyl Esters

The conversion of fatty acids into fatty acid methyl esters (FAME) was carried out using the transmethylation method with boron trifluoride (BF_3), in accordance with international standards [4]. A few drops of oil were dissolved in 1 mL of hexane, to which 0.4 mL of a methanolic sodium hydroxide solution was added. The mixture was refluxed at 60˚C for 10 minutes. Next, 0.5 mL of BF_3 reagent and 1 mL of hexane were added, followed by heating for three minutes. After vigorous shaking, the mixture was left to stand until two phases formed. Following cooling and decanting, the upper hexane phase containing the EMAG compounds was recovered.

2.3.2. Separation and Quantification by Gas Chromatography (GC)

The analysis of the EMAG was carried out by gas chromatography (GC). The experimental setup comprised an HP 5890 chromatograph fitted with a non-polar column (HP 5M) 30 metres long, with an internal diameter of 0.25 mm and a wall thickness of 0.2 µm. In addition, a flame ionisation detector (FID) was used, in accordance with ISO 12966-4 [5]. The carrier gas used was helium, flowing at a rate of 1 mL/min. The oven temperature was programmed to rise from 50˚C to 280˚C at a gradient of 5 ˚C/min. Furthermore, the injector and detector temperatures were set at 250˚C and 280˚C respectively. Finally, a volume of 1 µL of fatty acid methyl esters was injected for analysis.

The fatty acids were identified on the basis of their respective retention times. A mixture of known fatty acids, present in defined proportions, was injected under the same experimental conditions as the sample to be analysed. The retention time of each fatty acid was determined and its corresponding area was recorded.

In order to identify the fatty acids in the sample, their retention times were compared with those of known standards. The fatty acids were quantified by measuring the peak areas. A standard of known concentration, heptadecanoic acid (C17:0), was used in this process. The internal standard method was used to quantify the fatty acids via their methyl esters. By adding a known quantity of C17:0 to the fat under investigation, we were able to accurately determine the fatty acids present in the sample. The comparison of their peak areas was carried out relative to that of C17:0 as follows:

$$AG(mg) = masse(\mathrm{C17:0}) \times \left[\frac{Aire(AG)}{Aire(\mathrm{C17:0})} \right] \quad (1)$$

$$\%AG = \frac{AG(mg)}{AG\ totaux(mg)} \quad (2)$$

The identification of fatty acids, including very long-chain fatty acids (C20 - C26), was not based solely on theoretical retention times, but was confirmed by the injection of certified reference standards, such as the Supelco 37 Component FAME Mix, under the same analytical conditions, applying the appropriate response factors in accordance with the ISO 12966-4 standard.

2.4. Determination and Modelling of Triglycerides (TG)

2.4.1. Overall Experimental Analysis

The overall experimental analysis of triglycerides by total number of carbon atoms (C52, C54, etc.) was carried out by chromatography (GC). This method allows triglycerides to be grouped according to the sum of the carbon atoms in their three fatty acid chains.

The global experimental analysis of intact triglycerides, separated by their total number of carbon atoms (e.g., C52, C54), was carried out using gas chromatography (GC). The analysis was performed by the Institut Technique d'Études et de Recherche des Corps Gras (ITERG, Canéjan, France) in strict compliance with the standardized methods IUPAC 2.323 [6] and NF EN ISO 17678 (ISO. 2019) [7]. Following these normative protocols, the identification of triglyceride groups was performed by comparing their retention times with those of established reference standards, and relative quantification was achieved by determining the percentage of the respective chromatographic peak areas.

2.4.2. Probabilistic Distribution Approach

Experimental analytical methods (HPLC) sometimes struggle to separate all the regioisomers of triglycerides in complex oils. To overcome this difficulty and identify the exact molecular species in *P. macrophylla* oil, we used the "genetic code" method described by Ossoko *et al*., 2017 [8]. We therefore carried out mathematical modelling based on the statistical random distribution approach according to the 1,2,3-Random theory.

This approach posits that, during biosynthesis within the seed, the esterification of fatty acids at the three positions (sn-1, sn-2, sn-3) of the glycerol molecule fol-

lows a probability strictly linked to the molar concentration of each fatty acid in the oil.

The probability **[*P*]** of forming a triglyceride composed of fatty acids **[*A*]**, **[*B*]** and **[*C*]** is calculated using the following combinatorial formula:

$$P(A,B,C)=\frac{3!}{n_A!n_B!n_C!}\times[A]\times[B]\times[C]$$

where:

[*A*], **[*B*]** and **[*C*]** represent the molar fractions of the fatty acids in the oil.

ni is the number of times a specific fatty acid is repeated in the triglyceride.

The probabilities were calculated on the basis of the fatty acids identified by GC-FID: linoleic acid (*L*), oleic acid (*O*), lignoceric acid (*Li*), behenic acid (*Bh*), palmitic *acid* (*P*), cerotic acid (*Cr*), arachidic (*A*), stearic (*S*) and gondoic (*Gd*).

2.5. Statistical Analyses

Oil extraction was carried out in four independent technical replicates (n = 4) from the composite sample, and the yield is expressed as mean ± standard deviation (SD). Chromatographic analyses (fatty acid and triglyceride profiles) were performed on the composite oil. For these accredited analyses (ITERG), the dispersion of values is not a biological standard deviation, but represents the expanded measurement uncertainty (U), calculated with a 95% confidence level (k = 2) according to ISO standards. The uncertainty of the modeled probabilities was estimated by the mathematical propagation of this initial analytical uncertainty.

3. Results

3.1. Oil Extraction Yield

Oil extraction was carried out in four replicates to ensure the reliability of the results. The average yield obtained was 46.31 ± 1.38%. This high yield confirms that the kernels of *P. macrophylla* are particularly oil-rich.

3.2. Fatty Acid Composition

GC-FID analysis, following transmethylation with BF_3, enabled the identification and quantification of the fatty acid profile of *P. macrophylla* oil. The total fatty acid content measured was 90.368 g/100 g of oil. Table 1 details the percentages of the various fatty acids identified.

Table 1. Fatty acid composition of oil from *P. macrophylla* kernels collected in Ontogo, Republic of the Congo.

Fatty acid groups	Common name Fatty acid	Symbol	Yields (%)	Total yields by group (%)
Saturated Fatty Acid (SFA)	Myristic acid	14:0	<0.05%	**30.03 ± 2.40%**
	Palmitic acid	16:0	4.11 ± 0.50%	

Continued

	Margaric acid	17:0	0.06 ± 0.50%	
	Stearic acid	18:0	2.26 ± 0.50%	
	Arachidic acid	20:0	2.60 ± 0.50%	
	Behenic acid	22:0	6.62 ± 0.53%	
	Lignoceric acid	24:0	11.57 ± 0.93%	
	Cerotic acid	26:0	2.81 ± 0.50%	
Monounsaturated fatty acid (MUFA)	Palmitoleic acid and its isomers	16:1	0.07 ± 0.50%	**26.03 ± 2.08%**
	Heptadecenoic acid	17:1	<0.05%	
	Trans oleic acid	18:1 trans	<0.05%	
	Oleic acid (and its cis isomers)	18:1	24.33 ± 1.95%	
	Gondoic acid	20:1	1.49 ± 0.50%	
	Erucic acid	22:1	0.14 ± 0.50%	
	Nervonic acid	24:1	<0.05%	
Polyunsaturated Fatty Acids (PUFAs)	Trans-linoleic acid	18:2 trans	<0.05%	**43.89 ± 3.50%**
	Linoleic acid	18:2 cis	43.77 ± 3.50%	
	Trans-linolenic acid	18:3 trans	<0.05%	
	Linolenic acid	18:3 (n-3) cis	<0.05%	
	Eicosadienoic acid	20:2 (n-6)	0.12 ± 0.50%	

The results reveal an oil rich in PUFAs (43.89 ± 3.50%), completely devoid of omega-3, and dominated by linoleic acid (43.77 ± 3.50%). The distinctive feature of this profile lies in the saturated fraction (30.03 ± 2.40%), which consists almost exclusively of very long-chain fatty acids (VLCFAs) such as arachidic acid, behenic acid, cerotic acid and lignoceric acid, totalling 23.60 ± 1.89 per cent, with lignoceric acid being the predominant component (11.57 ± 0.93 per cent).

3.3. Experimental Analysis of Triglycerides

Chromatographic analysis of intact triglycerides enabled the molecules to be grouped according to their number of carbon atoms. Table 2 presents these overall results.

Table 2. Experimental determination of triglycerides in *P. macrophylla* oil by number of carbon atoms.

Triglycerides (Total number of carbon atoms)	Result (%)
C50	**0.80 ± 0.50%**
C52	**7.02 ± 0.56%**
C54	**35.26 ± 2.82%**

Continued

C56	**12.49 ± 1.00%**
C58	**18.62 ± 1.49%**
C60	**23.53 ± 1.88%**
C62	**2.28 ± 0.50%**
Unidentified	**< 0.1%**

This analysis reveals a fairly diverse composition, characterised by the predominance of the C54 group (35.26 ± 2.82%), followed by a significant presence of atypical groups with heavy structures such as: C60 (23.53 ± 1.88%), C58 (18.62 ± 1.49 per cent) and C56 (12.49 ± 1.00 per cent).

3.4. Determination of Triglycerides Using a Probabilistic Approach

To determine the detailed structure of the triglycerides comprising the (C52 to C62) groups, we applied the probabilistic model based on the proportions of the previously identified fatty acids, building on the method proposed by Ossoko *et al.* (2017) [8]: linoleic acid (43.77 ± 3.50%), oleic acid (24.33 ± 1.95%), lignoceric acid (11.57 ± 0.93%), behenic acid (6.62 ± 0.53%), palmitic acid (4.11 ± 0.50%), cerotic acid (2.81 ± 0.50%), arachidic acid (2.60 ± 0.50%) and stearic acid (2.26 ± 0.50%).

Indeed, considering the triglyceride groups identified experimentally, the only possible main structure for the majority C54 group consists of a combination of three C18 fatty acids, given that 3 × C18 = C54. Similarly, to obtain a heavy triglyceride from the C60 group, the dominant structural configuration requires the glycerol backbone to be linked to two C18 fatty acids and one C24 fatty acid (2 × C18 + C24 = C60).

This structural correlation enabled us to test the reliability of our mathematical model by comparing the theoretical probability of the macroscopic distribution of these two target groups (C54 and C60) with the experimental results obtained by chromatography (35.26% and 23.53%).

That said, when applied to the combinatorial formula, the theoretical calculation of the cumulative probability of C54-type triglycerides, consisting solely of C18 fatty acids (L, O, S), the sum of which is 70.36%, yields the value:

$$\mathbf{P[C(54)]} = (0.7036)^3 \times 100 = 34.83 \pm 2.79\%$$

Similarly, for the most common structural combination of C60-type triglycerides, consisting of two C18 acids and one C24 acid (a fraction of 0.1157 or 11.57 per cent), the calculation gives:

$$\mathbf{P[C(60)]} = 3 \times (0.7036)^2 \times (0.1157) \times 100 = 17.18 \pm 1.37\%$$

These theoretical values—34.83% for the C54 group and 17.18% for the C60 group. Although the probabilistic model demonstrates a strong predictive capacity for the major groups (such as C54, experimentally at 35.26 ± 2.82%), a significant divergence is observed for the C60 group (model estimate: 17.18 ± 1.37%

versus 23.53 ± 1.88% experimentally). This difference confirms the limitations of a pure 1,2,3-random distribution. Indeed, from a physiological perspective, the acyltransferases involved in the lipid biosynthesis of *P. macrophylla* appear to exert a strong enzymatic regioselectivity, favoring the specific accumulation and co-esterification of very long-chain fatty acids (C20 - C26) on the glycerol backbone, thus exceeding simple statistical probability. The probabilistic modelling of the major triglyceride species obtained using this approach is detailed in Table 3.

Table 3. Probabilistic modelling of the major triglyceride species in *P. macrophylla* using the stochastic crossover approach.

Triglycerides (Total number of carbon atoms)	Triglyceride Species	Fatty acid combination	Estimated probability (%)
C52	*LOP*	*Linoleoyl-oleoyl-palmitoyl glycerol*	2.63 ± 0.50%
	LLP	*Dilinoloil-palmitoylglycerol*	2.36 ± 0.50%
	OOP	*Di-oleoyl-palmitoyl glycerol*	0.73 ± 0.50%
C54	*LLO*	*Dilinoloil-oleoylglycerol*	13.98 ± 1.12%
	LLL	*Trilinolein*	8.39 ± 0.67%
	LOO	*Linoleoyl-dioleoyl glycerol*	7.77 ± 0.62%
	OOO	*Trioline*	1.44 ± 0.50%
C56	*LOA*	*Linoleoyl-oleoyl-arachidoyl glycerol*	1.66 ± 0.50%
	LLA	*Dilinoloil-arachidoilglycerol*	1.49 ± 0.50%
	LOGd	*Linoleoyl-oleoyl-gondooylglycerol*	0.95 ± 0.50%
C58	*LOBh*	*Linoleoyl-oleoyl-behenoylglycerol*	4.23 ± 0.50%
	LLBh	*Dilinoloil-behenoylglycerol*	3.80 ± 0.50%
	LPLi	*Linoleoyl-palmitoyl-lignoceroylglycerol*	1.25 ± 0.50%
	OOBh	*Dioléoyl-behenoylglycerol*	1.18 ± 0.50%
	OPLi	*Oleoyl-palmitoyl-lignoceroylglycerol*	0.69 ± 0.50%
C60	*LOLi*	*Linoleoyl-oleoyl-lignoceroylglycerol*	7.39 ± 0.59%
	LLLi	*Dilinoloil-lignoceroylglycerol*	6.65 ± 0.53%
	OOLi	*Dioléoyl-lignoceroylglycerol*	2.05 ± 0.50%
C62	*LOCr*	*Linoleoyl-oleoyl-cerotoylglycerol*	1.80 ± 0.50%
	LLCr	*Dilinoloil-cerotoylglycerol*	1.62 ± 0.50%
	LiLA	*Lignoceroyl-linoleoyl-arachidoylglycerol*	0.79 ± 0.50%

Continued

	BhLBh	*Behenoyl-linoleoyl-behenoylglycerol*	0.58 ± 0.50%
	OOCr	*Dioléoyl-cerotoylglycerol*	0.50 ± 0.50%
Others	*Minor mixtures*	*Remaining mixtures*	approximately 26.07%

(Key: *L* = linoleic, *O* = oleic, *Li* = lignoceric, *Bh* = behenic, *P* = palmitic, *Cr* = cerotic, *A* = arachidic, *Gd* = gondoic).

The probabilistic model reveals that the oil is not simply composed of a single predominant species, but of a rich mosaic of triglycerides. On the one hand, the classic fluid C54 triglycerides (*LLO, LLL, LOO*) form the oil base (bound to C18 fatty acids). On the other hand, the oil's unique signature is characterised by the extensive incorporation of very long-chain fatty acids (VLCFAs) to form heavy structured species, notably *LOLi* (7.39 ± 0.59%), *LLLi* (6.65 ± 0.53 per cent), *LOBh* (4.23 ± 0.50 per cent) and *LLBh* (3.80 ± 0.50 per cent).

4. Discussion

4.1. Oil Extraction Yield

The oil yield obtained (46.31 ± 1.38%) is significantly higher than the result obtained by Kabélé Ngiéfu *et al.* in 1979 (45.0%) in the former Zaire, in the Democratic Republic of the Congo [9]. Also in the Democratic Republic of the Congo, more recent studies report values for three distinct geographical origins that are perfectly in line with those obtained in this study (Lac de Ma Vallée: 46.12 per cent, Kikwit: 46.90 per cent, Mbanza Ngungu: 47.53 per cent) [10]. This similarity in results can be attributed to low soil and climate variability, which favours a relatively similar rate of lipid accumulation in *Pentaclethra macrophylla Benth* across different countries. Although slightly lower than that of commodity oils or argan oil (>50%), this rate confirms the strategic importance of this plant as a major oilseed resource for green chemistry and industrial utilisation in the Republic of the Congo.

4.2. Fatty Acid Profile

The lipid profile of *P. macrophylla* does not overlap with that of any conventional vegetable oil. Whilst oils rich in polyunsaturated fatty acids, such as linseed or hemp, derive their profile from alpha-linolenic acid (Omega-3) [11] [12], *P. macrophylla* is dominated by linoleic acid (Omega-6) at 43.77%, whilst being completely devoid of alpha-linolenic acid.

Its key distinguishing feature lies in its atypical saturated fatty acid fraction (30.03 per cent). Unlike olive or argan oil, where saturated fatty acids are limited to palmitic and stearic acids [13] [14].

P. macrophylla accumulates very long-chain fatty acids (VLCFAs: C24:0, C22:0, C26:0, C20:0), which account for nearly 24 per cent of the fat content. From a

metabolic and nutritional perspective, this difference is critical because fatty acids of the C16 and C18 groups at the Sn-2 position are readily hydrolysed by pancreatic lipase, whereas VLCFAs at the Sn-2 position undergo limited hydrolysis due to steric hindrance at the active site [15]. Consequently, whilst olive oil is recognised for its cardioprotective effects linked to oleic acid, *P. macrophylla* exhibits a distinct metabolic profile that would limit the absorption of its predominant saturated fatty acids. At the same time, the complete absence of omega-3 in *P. macrophylla* oil reduces its overall nutritional value and its effectiveness in preventing cardiovascular disease, due to an infinite omega-6/omega-3 ratio.

However, from a physiological and functional perspective, this abundance of VLCFAs is crucial and useful in industry. Indeed, VLCFAs have very high melting points, such as 80˚C to 85˚C for lignoceric acid and behenic acid. Their high concentration makes this oil rheologically similar to "vegetable butters" whilst conferring excellent oxidative stability.

4.3. Triglyceride Architecture: Validation of the Probabilistic Approach

Experimental macroscopic analysis revealed a very broad molecular architecture (C50 to C62), contrasting with the classic bimodality of most tropical fluid oils, such as *Tetracarpidium conophorum*, which relies solely on the C52 and C54 groups [16]. The probabilistic crossover method fully accounts for this chromatographic spread.

By modelling the cross-linking between the predominant C18 chains and VLCFAs, the model predicted the formation of a complex triglyceride profile. The major C54 species identified (*LLO*: 13.98 ± 1.12%, *LLL*: 8.39 ± 0.67%, *LOO*: 7.77 ± 0.62%) link *P. macrophylla* oil to conventional linoleic oils. However, the prediction of heavy species such as *LOLi* (C60: 7.39 ± 0.59%), *LLLi* (C60: 6.65 ± 0.53%) or *LOBh* (C58: 4.23 ± 0.50%) explains the detection of massive chromatographic peaks with more than 54 carbon atoms. Research conducted by Silou, T. (2014) from the Republic of the Congo [17] corroborates our results by reporting the presence of triplets such as dilinoleoyl-oleoylglycerol (*OLL*), trilinolein (*LLL*) and linoleoyl-dioleoylglycerol (OOL).

It is crucial to note, from a stereospecific perspective, that plant acyltransferases (LPAATs) selectively direct unsaturated acids (C18) to the sn-2 position, whilst steric hindrance pushes VLCFAs towards the outer sn-1 and sn-3 positions, as demonstrated by the work of Odile Morin (2015) on the distribution (%) of fatty acids in the outer and inner positions of linseed oil triglycerides [12]. This natural "lipid coding bias" results in hybrid triglycerides that are part-fluid, part-solid. From a digestive metabolic perspective, pancreatic hydrolysis of VLCFAs is limited, which restricts their nutritional absorption. Conversely, in dermo-cosmetics, this hybrid architecture structurally mimics the organisation of lipids in the stratum corneum, offering a natural substitute for synthetic ceramides (barrier repair). Given this specific structure (*LOLi and LLLi* triglycerides), the agro-indus-

trialisation of this Congolese oil opens up immediate prospects for innovation in the dermo-cosmetics (skin barrier repair) and green chemistry sectors, extending far beyond mere nutritional applications.

5. Conclusions

This study has enabled the lipid composition of *Pentaclethra macrophylla* kernels from the Cuvette region (Republic of the Congo) to be characterised with a high degree of precision. The application of the probabilistic statistical method to determine the architecture of this oil proved effective and revealed the presence of atypical triglycerides with long C60 and C58 chains.

The oil studied exhibits hybrid characteristics: it combines the fluidity of polyunsaturated (omega-6) and monounsaturated (omega-9) fatty acids with the structural rigidity conferred by an impressive pool of VLCFAs (lignoceric, behenic, cerotic and arachidic acids). Although its lack of omega-3 limits its use as a superfood, the hydrophobic nature of its hybrid triglycerides opens up exceptional prospects. Its biostructural affinity with the lipids of the stratum corneum of the epidermis positions it as a natural biomimetic substitute for synthetic ceramides.

Ethics Declaration

The authors declare that the study does not involve humans nor animal subjects.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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