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Composition of Fatty Acids and Tocopherols Content in Oilseeds of Six Wild Selected Plants from Kahuzi-Biega National Park/DR. Congo

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Authors' contributions

This work was carried out in collaboration between all authors. Authors KM, BS, JNK and PTM conceived experiment and designed the experiments. Authors KM, BS and MB performed experiments. Authors KM, JNK, MB, ANK and PTM analyzed the data. Authors KM, JNK, MB and PTM wrote the paper. All authors read and approved the final manuscript.

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ABSTRACT

Objective: Kahuzi-Biega National Park (KBNP) in Democratic Republic of the Congo is packed with fantastic oilseed plants that need to be analysed in order to promote a sustainable exploitation for both commercial and food supply purposes. The study aimed to determine the content of Fatty acids (FAs) and Tocopherols in the oilseeds from *Eckebergia capensis* Sparrman (Meliaceae), *Entada abyssinica* Steud. ex A. Rich (Leguminosae), *Macaranga kilimandscharica* Pax

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(Euphorbiaceae), *Prunus africana* (Rosaceae), *Sesbania sesban* L. (Fabaceae) and *Telfairia pedata* (Cucurbitaceae) using gas liquid chromatography and HPLC.
Results: The respective oil yields for the six studied plants ranged from a minimum of 7.2% for *S. sesban* seeds to a maximum of 42.2% for *P. africana* seeds. Eighteen FAs were detected, of which, five saturated (SFAs), six monounsaturated (MUFAs) and seven polyunsaturated (PUFAs). The SFAs fraction was dominated by stearic acid varying from 5.95 % in *M. kilimandscharica* oil to 76.19% in *P. africana* oil. The content in PUFAs fraction represented by linoleic acid an omega-6 fatty acid varied from 3.19% in *P. africana* oil to 58.82% in *S. sesban* oil while alpha-linolenic acid an omega-3 accounted for 0.32% in *P. africana* oil to 5.88% in *S. sesban* oil. The MUFAs fraction represented by oleic acid an omega-9 fatty acid varied from 3.4% in *P. africana* oil to 41.77% in *T. pedata* oil. The highest content of tocopherols was 10.9 mg/100 g in *S. sesban* oil, followed by *E. abyssinica* (7.9 mg/100 g) and *M. kilimandscharica* oil (4.9 mg/100 g).
Conclusion: The findings will help select the appropriate plant for specific desired FAs and tocopherols.

Keywords: Oilseed plants; Kahuzi-Biega National Park; fatty acids; tocopherols.

1. INTRODUCTION

Many studies have reported about the nutritional, medical and industrial benefits of oilseed plants [1-5]. The profiles of FAs give good information on both the nutritional quality and the performance of raw materials used for industrial applications [6]. At the public health level, it has been claimed that about one-third of the world's population –mostly children and women – are deficient in at least one essential nutriment that can be provided by consuming oilseeds [7]. Oilseeds contain energy, nutrients including vitamins and minerals, and other health beneficial components such as antioxidants.

Edible vegetable oils mainly consist of triglycerides with various fatty acids (FAs) which are responsible for their nutritional and physicochemical properties. Besides the major FAs present, several phytochemical detectable in oils may include phenolic and polyphenolic compounds, tocopherols and carotenoids as active molecules [8]. There is direct relationship between total phenolic content and antioxidant capacity of food. Carotenoids and tocopherols are essential vitamins that have particular nutritional and protective properties from their antioxidant activity. Tocopherols are kind of fat-soluble vitamin-E isomers. They possess potent antioxidant properties that make them anti-inflammatory, antimutagenic and antitumor potentials [9,10].

Nowadays, as the global human population continues growing, there is steadily more need to find alternative sources of FAs and tocopherols that could be used as food supplement without increasing final product costs.

Kahuzi-Biega National Park (KBNP) in the Democratic Republic of the Congo (DRC) is packed with fantastic oilseed plants that need to be analysed in order to promote a sustainable exploitation for both commercial and food supply purposes. KBNP is a very vast expanse of dense primary tropical forest situated within the species-rich Albertine Rift. The Park is home of Grauer's Gorilla endemic to the region. KBNP has an exceptional high floral diversity with over 1,100 recorded species, of which 145 are endemic to the Albertine Rift [11]. Situated in one of the most densely populated regions of DRC, the threats for KBNP are settlements and land clearing for agriculture, poaching and hunting for bush meat, logging and mineral extraction [12]. Thus some important plant species in KBNP and surrounding areas are threatened with extinction [13].

A series of endeavours and studies have been undertaken to scientifically highlight the value of oilseed plants growing in KBNP by documenting their nutriment composition in order to validate and valorise their uses [6]. In the present study we have selected six wild plants surrounding KBNP, used by the local populations mainly for nutrition and medical purposes, to evaluate the oil yield and determine the composition of FAs and tocopherols in those species. These plants are: *Eckebergia capensis* Sparrman (Meliaceae); *Entada abyssinica* Steud Ex.A.Rich (Leguminosae); *Macaranga kilimandscharica* Pax (Euphorbiaceae); *Prunus africana* (Rosaceae); *Sesbania sesban* L. (Fabaceae);

and *Telfairia pedata* (Cucurbitaceae). Their photos in Fig.1 could help recognize them. They are all evergreen trees found in Afromontane forests that are growing in different parts of Africa and some are commercialized [14-19]. They are resorted in folk medicines to be aperient, diuretic, emetic, emmenagogue, febrifuge, laxative, tonic, antiviral, etc. *Prunus africana* is used to treat benign prostate hyperplasia. *Telfairia* seeds are eaten raw or cooked and nuts are especially mentioned as source of food for women during the lactating period. After oil extraction the residue makes a valuable cake for livestock feeding [20]. Some studies have been undertaken on species from other countries to identify the bioactive chemicals from bark extracts and FAs from oilseeds, but not yet on the species from KBNP.

2. MATERIALS AND METHODS

2.1 Oil Extraction and Quantification

Around 500 g of oilseeds were handily harvested from wild plants in the park and brought to the phytochemistry laboratory of CRSN/L "Centre de Recherche en Sciences Naturelles de Lwiro" where they were before sun dried during 5-8 days and then completed at 105°C in oven for 1-3 hours (model Boekel, Arthur H. Thomas Co. Philadelphia, USA). After drying, the seeds were shelled by hand to expel the kernels and then crushed with a coffee-mill (model Corona 01 Landers & CIA.SA) to produce fine seed flours. The respective fine flours were extracted by repeated washing with petroleum ether (boiling point 40-60°C) using the Soxhlet's procedure [20] for 8 hours. The oil dissolved in petroleum ether was filtered through filter paper and the solvent evaporated under vacuum in a rotary evaporator model Eyala of Tokyo Rikakikai Co. Ltd. The remaining solvent traces were removed by heating the flask containing the oil in water bath (50°C). The oil content was weighted and the yield expressed as percent of the fine flour mass.

2.2 Determination of Fatty Acids Content by GC

The fatty acid composition was determined following the ISO standard ISO 5509:2000 [21]. In brief, one drop of the oil was dissolved in 1 mL of n-heptane; 50 µg of sodium methylate was added, and the closed tube was agitated vigorously for 1 min at room temperature.

Fig. 1. Photography of the six studied plants

After addition of 100 µL of water, the tube was centrifuged at 4500 g for 10 min and the lower aqueous phase was removed. Then 50 µL of HCl (1 mol with methyl orange) was added, the solution was shortly mixed, and the lower aqueous phase was rejected. About 20 mg of sodium hydrogen sulphate (monohydrate, extra pure; Merck, Darmstadt, Germany) was added, and after centrifugation at 4500 g for 10 min, the top n-heptane phase was transferred to a vial and injected in a Varian 5890 gas chromotograph with a capillary column, CP-Sil 88 (100 m long, 0.25 mm ID, film thickness 0.2 µm). The temperature program was as follows: from 155°C; heated to 220°C (1.5°C/min), 10 min isotherm; injector 250°C, detector-FID 250°C; carrier gas 36 cm/s hydrogen; split ratio 1:50; detector gas 30 mL/min hydrogen; 300 mL/min air and 30 mL/min nitrogen; manual injection volume less than 1 µL. The peak areas were computed by the integration software, and percentages of fatty acid methyl esters (FAMEs) were obtained as weight percent by direct internal normalization (methyl tricosanoate C23:0 internal standard). The peaks were recognized, based on their retention times (RT) using standard FAMEs.

2.3 Determination of Tocopherols Content

For determination of tocopherols, the DGF F-II 4a method was used [22,23]. In brief, a solution of 250 mg of oil in 25 mL of n-heptane was directly used for the HPLC. The HPLC analysis was conducted using a Merck-Hitachi low-pressure gradient system, fitted with a L-6000 pump (Merck-Hitachi, Darmstadt, Germany), a Merck-Hitachi F-1000 fluorescence spectrophotometer (Darmstadt, Germany, detector wavelengths for excitation 295 nm, for emission 330 nm), and a ChemStation integration system (Agilent Technologies Deutschland GmbH, Böblingen, Germany). The samples in the amount of 20 µL were injected by a Merck 655-A40 autosampler (Merck-Hitachi, Darmstadt, Germany) onto a Diol phase HPLC column 25 cm × 4.6 mm ID (Merck, Darmstadt, Germany) used with a flow rate of 1.3 mL/min. The mobile phase used was n-heptane/tert-butyl methyl ether (99 + 1, v/v). The mobile phase used was 99 mL *n*-heptane + 1 mL tert-butyl methyl ether. The mean values were given in the tables, without the standard deviation, because this value would represent only the deviation of the method and not the variation of the appropriate sample.

3. RESULTS

The respective oil yields for the six plants studied are shown in the Table 1. These values ranged from a minimum of 7.2% for *S. sesban* seeds to a maximum of 42.2% for *P. africana* seeds.

Fig. 2 shows that *P. africana* and *E. capensis* seed oils are rich in saturated FAs (SFAs), while mono-unsaturated (MUFAs) were in *T. pedata* and *M. kilimandscharica* oils and polyunsaturated (PUFAs) in *S. sesban oil*.

Table 2 shows the distribution of the eighteen FAs detected, of which, five were SFAs including Palmitic (16:0), Stearic (18:0), Arachidic (20:0), Behenic (22:0), and Lignoceric (24:0); six were MUFAs including Palmitoleic (16:1D9), Elaidic (18:1), Oleic(18:1D9), Vaccenic (18:1D11, Eicosenoic (20:01), 11-Eicosenoic (20:1 11); and seven were PUFAs consisting of Linoelaidicic (18:2trans1), Linoleic (18:2), α-Linolenic (18:3), Eicosadienoic (20:2 11,14), Eicosatrienoic (20:3 5,11,14), Eicosatetraenoic (20:4 5,11,14,17) and Eicosatetraenoic (20:4).

The SFAs fraction was dominated by stearic acid (C18:0) varying from 5.95 % in *M. kilimandscharica* to 76.19% in *P. africana* oils. The fraction of MUFAs is represented by linoleic acid (LA 18:1 D9) an omega-6 from 3.19% in *P. africana* oil to 58.82% in *S. sesban* oil. The PUFAs fraction is represented by linoleic acid (C18:2) an omega-9 fatty acid from 3.4% for *P. africana* oil to 41.77% for *T. pedata o*il. Alpha-linolenic acid (ALA 18:3) an omega-3 accounted from 0.32% for *P. africana* to 5.88% for *S. sesban* oil.

In addition to the common FAs, very long-chain FAs (VLCFAs) with 20 carbons or more were detected in the investigated samples particularly in *M. kilimandscharica* and *P. africana,* and less in *S. sesban* oil.

Table 3 indicates that the high content of tocopherols was in S. s*ebsban* oil (10.9mg/100g), *E. abyssinica* oil (7.9 mg/100 g) and *M. kilimandscharica* oil (4.9 mg/100 g).

Table 1. Scientific name, local name and seed oil content of wild oilseed plants from Kahuzi-Biega National Park, kivu, DR. Congo

Plant scientific name		Family	Local name	Oil yield (%W/W)
EC	*Eckebergia capensis Sparrman*	Meliaceae	Kaobeobe	22.3%
EA	*Entada abyssinica Steud. ex A. Rich*	Leguminosae	Cishangishangi	36.1%
MK	*Macaranga kilimandscharica Pax*	Euphorbiaceae	Mushesha (Shi)	9.2%
PA	*Prunus africana*	Rosaceae	Muhumbahumba	42.2%
SS	*Sesbania sesba L.*	Fabaceae	Munyegenyege	7.2%
TP	*Telfairia pedata*	Cucurbitaceae	Muhirehire	29.3%

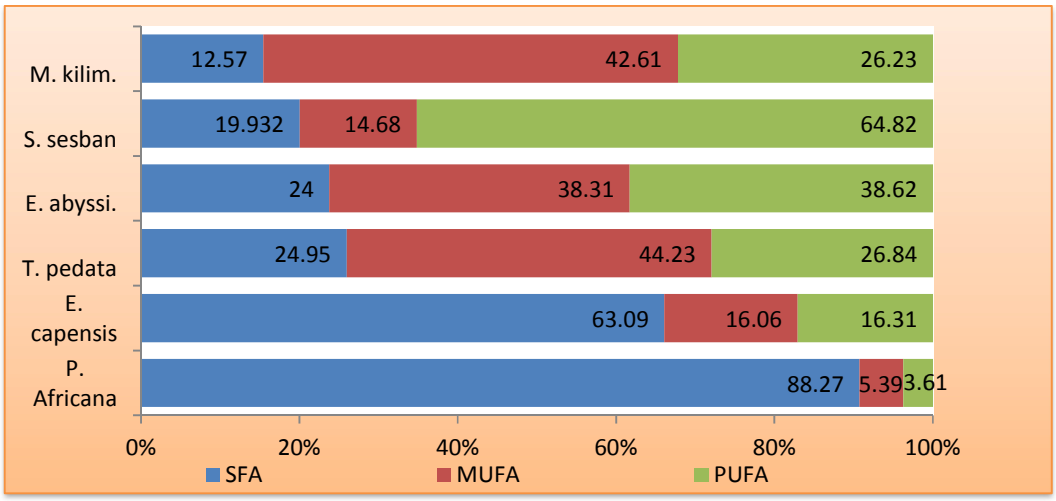

Fig. 2. Variation of saturated (SFAs), monounsaturated (MUFAs) and polyunsaturated (PUFAs) Fatty acid fractions in oils of six wild oilseed plants from KBNP/ DR. Congo

Table 2. Fatty acids composition (%w/w) in oils of six wild oilseed plants from KBNP/DR. Congo

Fatty acids	Plant abbreviation and content in % (w/w)					
	EC.	***EA***	***MK.***	***PA.***	***SS.***	***TP.***
Palmitic (16:0)	6.83	11.00	4.22	3.78	13.32	14.06
Palmitoleic (16:1D9)	0.14	-	-	0.85	-	0.6
Stearic (18:0)	51.12	8.36	5.95	76.19	5.98	9.13
Elaidic (18:1)	-	-	8.23	-	-	-
Oleic (18:1 D9)	14.46	37.09	32.00	3.40	13.73	41.77
Vaccenic (18:1 D11)	0.32	0.52	0.23	0.12	0.63	0.68
Linoelaidicic (18:2 trans1)	-	-	2.66	-	-	-
Linoleic (18:2)	14.66	36.77	12.63	3.19	58.82	22.03
α-Linolenic (18:3)	1.17	0.42	1.07	0.32	5.88	0.74
Arachidic (20:0)	5.03	2.34	0.82	8.18	0.53	0.88
Eicosenoic (20:01)	0.57	-	-	-	-	-
11-Eicosenoic (20:1 11)	0.57	0.7	2.15	1.02	0.32	1.18
Eicosadienoic (20:2 11,14)	0.19		3.25		0.12	1.17
5,11,14-Eicosatrienoic (20:3 5,11,14)	-	-	2.34	-	-	-
5,11,14,17-Eicosatetraenoic (20:4 5,11,14,17)	0.29	-	3.64	-	-	2.22
Behenic (22:0)	0.11	-	1.05	0.12	0.39	0.88
Eicosatetraenoic (20:4)	-	1.43	0.64	0.1	-	0.68
Legnoceric (24:0)	-	2.3	0.53	-	-	-

EC (eckebergia capensis sparrman) , EA (entada abyssinica steud. ex A. Rich) , MK (macaranga kilimandscharica pax), PA (prunus africana), SS (sesbania sesba L.) TP (telfairia pedata)

Table 3. Tocopherols content in oils of six wild oilseed plants from KBNP/ DR. Congo

Tocopherols type	Plants and tocopherols content (mg/100g oil)					
	EC	EA	MK	PA	SS	TP
α-Tocopherol	0	0.1	0.1	0	3.8	0.3
α-Tocotrienol	0.1	0.1	0.1	0.1	0.2	0.1
β-Tocopherol	2.2	2.3	3.2	1.8	1.7	1.4
γ-Tocopherol	0.1	3.9	0	0	4.4	0.1
β-Tocotrienol	0	0	0	0	0	0
Plastochromanol-8	0	0.1	0.1	0	0	0
γ-Tocotrienol	0.8	0.8	1.5	0.6	0.7	0.5
δ-Tocopherol	0	0.6	0	0	0	0
δ-Tocotrienol	0	0	0	0	0	0
Total content	3.2	7.9	5.0	2.5	10.8	2.4

4. DISCUSSION

The oil yields found in the current six studied plants range from 7.2% to 42.2%. This yield is satisfactory enough if we compare with many oilseeds available on the international market such as cottonseed (18-25%), soya bean (15-20%), peanut (45-55%), and palm oil (30-60%) [24-27].

The oil yield may vary with the extractive methods used. For example, Malimo sylvia [28] compared the yield of extraction of oyster nut (*Telfairia pedata* Sims Hook) and found that Soxhlet process was the best of the three methods used. It gave an oil yield of 63.9% while the biotechnical rotar evaporation gave 28.0% and with centrifugation, it gave 30.3% oil yield. The oil yield by soxhlet method combined with rotar evaporation in our *T. pedata* species averaged 30%.

The content of FAs in oilseeds may vary with the origin of the plants. For instance *T. pedata* seed oil has been reported by Okoli [29] as containing linoleic acid (32.5%), palmitic acid (24.5%), stearic acid (18%), oleic acid (11.5%) and 5% of Alpha-linoleic acid. In the current species, we have found linoleic acid (22%), palmitic acid (14%), stearic acid (9%) and oleic acid (42%) not mentioning polyunsaturated derivatives.

Abyssinian oil (Lotioncrafter LLC) was promoted as new natural seed *oil* with an ultra light, non-greasy skin feel as it contains a high percentage of unsaturated C22 fatty acids [15]. The fatty acid profile of the marketed FANCOR® Abyssinian Oil is typically presented as containing palmitic (1-4%), palmitoleic (0.1-0.5%), stearic (0.5-2%), oleic (10-25%), linoleic (7-15%), linolenic (2-5%), arachidic (0.5-2%), eicosenoic (2-6%), eicosadienoic (0-0.5%), behenic (1-3%), erucic acid (50-65%), and lignoceric (0-1%) [15]. However, the Erucic acid which appears dominant in FANCOR® was not detected in our *E. abyssinica* oil.

The profile of FAs composition of the six studied plants varied a lot. The FAs profile of *E. capensis* and *P. africana* oils is similar to those of butter and coconut oils while *M. kilimandscharica* and *S. sesban* profiles are sunflower and corn oils-like. Fig. 1 showed that in *T. pedata* and *E. abyssinica* oils there was equilibrium between SFAs, MUFAs and PUFAs fractions while SFAs dominate *in E. capensis* and *P. africana,* MUFAs in *M. kilimandscharica* and PUFAs in *S. sesban.*

Thus, *T. pedata, S. sesban* and *E. abyssinica* oils could have great economic value as oleic acid sources in comparison to 59-75% found in the pecan oil, 61% in canola oil, or 20-85% reported for peanut oil and sunflower oil [30].

Stearic acid is the highest molecular weight SFA occurring abundantly in fats and oils. It occurs in small quantities in seed and marine oils. Besides its major food sources for adults that are meat/poultry/fish, grain products, and milk/milk products, stearic acid is also found in Cocoa butter (55%), Mutton tallow(41%), Beef tallow(38%), Lard(34%), Butter(19%), Soybean oil(26%), Coconut oil(3%), Olive oil(14%) and Corn oil(14.%) [30]. In the current studied plant oils, *P. africana* and *E. capensis* oils are rich in stearic acid (76.2% and 51.1% respectively), making them worth sources for this FA.

Unlike other predominant long-chain SFAs – palmitic (C16:0), myristic (C14:0), and lauric (C12:0) acids - which increase blood cholesterol levels - stearic acid has been shown to have a neutral effect on blood total and low density lipoprotein (LDL) cholesterol levels [31,32].

Stearic acid's neutral effect on blood total and LDL cholesterol levels implies that this long-chain SFA may not increase the risk for cardiovascular disease. For this reason, it has been suggested that stearic acid not be grouped with other long-chain SFAs, although to date this recommendation has not been implemented in dietary guidance or nutrition labeling [31,32].

The study of Dambatt and Ogah in Kenya [33] found that the oil content of the *S. sesban* seed extracted with 40/60 petroleum ether in a Soxhlet apparatus yielded 4.6% and FAs detectable by GLC were oleic (87.4%), palmitic (10.8%), caprylic (0.4%), and caproic (0.8%). For this study, *S. sesban* oil yielded 7.2% and the major FA is lineloic acid (55%); palmitic and oleic acid accounted instead for only 13% each. Furthermore, the oil of *S. sesban* species contains enough amount of omega-3 ALA (5.88%) compared to soybean which is commercial source of ALA or to other commercial oils such as peanut oil (0.4%), sesame oil (0.4%) and sunflower oil (0.5%).

However the ratio of omega-6 to omega-3 FAs is 12:1 for *M. kilimandscharica*, 10:1 for *P. Africana,* 10:1 for *S.sesban*, 20:1 for *T. pedata,* 13:1 for *E. capensis*, and 88:1 for *E. abyssinica*. The current recommended dietary ratio of omega-6:omega-3 FAs is about 10:1 according to FAO guideline while Modern Western diets exhibit omega-6: omega-3 ratios ranging between 15:1 and 17:1[34,35]. Thus only *T. pedata*, and *E. abyssinica* have bad ratios. It has been said that excessive amount of LA and a very high LA/ALA ratio could trigger or enhance the pathogenesis of many diseases, including coronary heart disease (CHD), cancer, inflammation and autoimmune diseases [35]. Due to the opposing effects of omega-3 and omega-6 fatty acids, a healthy diet should contain a balanced omega-6: omega-3 ratio. Epidemiology and dietary intervention studies have demonstrated that while an exceptionally high omega-6: omega-3 ratio promotes the development of many chronic diseases, a reduced omega-6: omega-3 ratio can prevent or reverse these diseases [35].

Groundnut oil which has arachidic acid (AA) content ranging from 2 to 4% is known as the vegetable source of this FA. In the studied plants, *E. abyssinica*, *E. capensis* and *P. africana* oils had 2.34%, 5.03% and 8.18% of AA respectively.

There is surprisingly very high amount of *trans*-FAs in *S. sesban* seed oil containing 8.23% of *trans*-oleic (Elaidic acid) and 2.66% of *trans*-LA (Linoelaidicic acid). High amounts of *trans* fats correlate with circulatory diseases such as atherosclerosis and chronic heart disease more than the same amounts of non-*trans* fats [33-37]. The maximum content recommended for *trans*-acids in food products is 1.0% [36]. Dietary *trans*-acids come mainly from oil partial hydrogenation, in dairy fats where they are formed by bio-hydrogenation in the rumen, and through exposure to high temperatures [38-40]. Thus, the presence of trans-FAs in *S. sesban* oil could be attributed to erroneous exposition to high temperature during the processing method precisely during oil extraction.

In addition to the common FAs, very long-chain FAs (VLCFAs) with aliphatic tails longer than 22 carbons were detected in the investigated samples particularly in *M. kilimandscharica* seed oil and *P. africana* seed oil. *M. kilimandscharica* seed oil and *P. africana* seed oil as new sources of VLCFAs oils for industry.

VLCFAs are important in the oleo-chemical industry where they cover about 6% of the industry requirements in FAs [41,42]. They are used specifically in the manufacturing of some products such as high-grade candles. There are comparatively few common vegetal fats that contain appreciable amounts of VLCFAs. They are currently produced by transgenetic modification of some plant species [41]. However, for nutrition, unlike most fatty acids, VLCFAs are too long to be metabolized in the mitochondria, and must be metabolized in peroxisomes. Certain peroxisomal disorders, such as adrenoleukodystrophy, can be associated with an accumulation of VLCFAs [43].

Tocopherols and Tocotrienols are natural form of vitamin E. The main recognized biochemical function of tocopherols is the protection of polyunsaturated FAs against peroxidation. They display antioxidant activity which protects the body tissues against the damaging effects, caused by the free radicals resulting from many normal metabolic functions [44-46]. Most food plants contain low to moderate levels of vitamin E activity. Soybean oil is the most consumed vegetable oil in the world, representing 30% of the consumption in the worldwide market. Soybean deodorizer distillate (SODD), a deodorized byproduct is an alternative to marine animals as natural source of squalene and as a

good raw material for the production of fatty acid steryl esters (FASEs), free phytosterols, and tocopherol [47].

In the investigated plants, *S. sesban* seed oil is rich in tocopherols content (10.7 mg/100 g) followed by *E. abyssinica* seed oil (7.9 mg/100 g) and *M. kilimandscharica* seed oil (4.9 mg/100 g). Plastochromanol-8 which is among the major vitamin E components in olive oil is only in traces in *E. abyssinica* and *M. kilimandscharica* (0.1 mg /100 g). Moreover, *E. abyssinica* is rich in beta (2.3 mg/100 g) and gamma (3.9 mg/kg) tocopherols, while *S. sesban* oil has mixed alpha (3.8 mg/kg), and gamma (4.4 mg/100 g) tocopherols. *S. sesban* and *E. abyssinica* oils are the most appropriate as sources of tocopherols.

Alpha-tocopherol is the form of vitamin E that is the most active tocopherol against peroxyl radicals ($LOO^{\cdot}$); delta-tocopherol is the least active (alpha>beta=gamma>delta) [48,49]. Beta-tocopherol is a natural tocopherol with less antioxidant activity than alpha-tocopherol. Gamma-tocopherol is the major form of vitamin E in many plant seeds and in the US diet, but has drawn little attention compared with alpha-tocopherol [48]. Despite the fact that studies are controversial, recent studies indicate that gamma-tocopherol may be important to human health and that it possesses unique features that distinguish it from alpha-tocopherol. Unlike alpha tocopherol, gamma tocopherol is a potent defender against reactive nitrogen oxides. Furthermore, gamma tocopherol has been found to reduce inflammation, regulate factors that guard against certain cancers and activate genes involved in protecting against Alzheimer's disease [48]. Mixed tocopherols help prevent cardiovascular disease.

5. CONCLUSION

The findings could help select the appropriate plant for specific desired FAs. *Eckebergia capensis and Entada abyssinica* have arachidic acid content similar and even above that of groundnut oil and can serve as alternative sources of that fatty acid. *Telfairia pedata, Sesbania sesban* and *Entada abyssinica* oils could be considered as new sources of oleic acid while *Prunus africana* and *Eckebergia capensis* oils rich in stearic acid can be replacer of commercial oil sources of this last fatty acid. *Sesbania sesban* and *Entada abyssinica* seed oils may be suitable oil seed crop for the various industries due to their very low content of linolenic and high content of linoleic acid. The fatty acid profiles of *Eckebergia capensis* and *Prunus Africana* seed oils are similar to those of Butter and coconut oil while those of *Macaranga kilimandscharica* and *Sesbania sesban* are similar to those of Sunflower and Corn oils. Thus they can be substitutes to these expensive fats and oils.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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