World Journal of Pharmaceutical Sciences
ISSN (Print): 2321-3310; ISSN (Online): 2321-3086
Published by Atom and Cell Publishers
Available online at: http://www.wjpsonline.org/
Original Article

Minerals and fatty acid composition analysis of *trichilia emetica* seed oil and the possibility of its use in cosmetic preparation

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Received: 27-09-2015 / Revised: 28-10-2015 / Accepted: 29-10-2015

ABSTRACT

Due to the abundance of *Trichilia emetica* in south-west part of Ethiopia and considering unutilized oilseed by the local community, this work was carried out to determine the potential application of seed oil in cosmetic preparation by investigating the fatty acid composition as well as minerals content. The fatty acid composition and the minerals content of the seed oil were determined by GC-MS and AAS respectively in Addis Ababa University, department of chemistry. The results showed that the major component of *Trichilia emetica* seed oil was palmitic acid (52.36%), followed by oleic acid (36.70%), linoleic acid (7.59%), stearic acid (1.99%) and cis-vaccenic acid (1.36%), all the fatty acids were expressed in methyl esters. The result of minerals elemental analysis of the seed oil reveals the presence of Ca (1.668ppm), Cr (0.7061ppm), Cd (0.0387ppm), Zn (0.0245ppm) and Cu (0.0184ppm). The concentration of Ni and Pb in the seed oil is below detection limits which indicate that the oil is safe for different industrial applications.

Keywords: Fatty acids, *Trichilia emetica* seed oil, GC-MS

INTRODUCTION

Seed oils have been used for centuries by rural communities as food, medicine, for cosmetic applications and as fuel. Recently there has been a renewed interest in these non-timber forest products specifically for use in cosmetic formulations. The cosmetic and pharmaceutical industries are constantly faced with the challenge of developing new products and improving existing ones in order to satisfy the ever changing demands of the customer, at the same time keeping abreast with regulatory and safety requirements. There is therefore an increase in the use of natural and organic cosmetic products as alternatives to animal-based and synthetic products [1]. Numerous researchers [2-4], among others have carried out a lot of analytical works on seeds primarily because of extensive and increasing demands for them both human consumption and numerous industrial applications. Because of the high demand and economic importance of these oilseeds to the chemical industry, attentions have therefore been focused on underutilized oilseeds viz., *Trichilia emetica* oilseed grown in Tepi, Ethiopia for possible development and use. *Trichilia emetica* (Meliaceae), also known as the Natal mahogany, is an evergreen tree reaching 20m but occasionally even up to 35m in height. It has red-brown or grey-brown bark and the leaves are dark glossy green on the upper surface and covered with brownish hairs on the lower surface. The flowers are small, creamy to pale yellow-green, and fragrant. The furry, rounded, red-brown fruit capsules (3cm across); contain 3-6 shiny black seeds (1.4-1.8cm) with a large fleshy scarlet or orange-red aril [5]. This plant is used to treat various diseases such as abdominal pains, dermatitis and chest pain in traditional medicine [6]. It is also used in the treatment of hemorrhoids, mental illness, epilepsy, abscess, typhoid fever, malaria, hypertension, witchcraft, and sight trouble. The main used parts are the leaves and the roots in powder form decoction and maceration. Concoction administration is by oral route, body bath or direct application on the skin [7]. External application of the pounded bark is used to treat parasitic skin, infections and inflammation in West Africa [8]. In Eastern Africa, the root bark decoction is better for emetic, purgative, fever, epilepsy, leprosy and makes women fecund [9]. In this same African region, *Trichilia emetica* is used against poisoning, hepatitis, ulcer, dysmenorrhea, asthma, cirrhosis and internal worms. Its fruits are used as diuretic [10]. Decoction of fresh leaf twigs is drunk in colic, in case of convulsions and fever. A decoction of

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the roots is used against jaundice and is better against intestinal worms [11]. In Senegal, the leaf decoction of *Trichilia emetica* is used against skin diseases, malaria, scabies and insomnia; and for its stimulatory properties in bronchial secretions [12]. The plant is used as general tonic and for bronchial inflammation [13]. Leaf and roots decoctions are used for bathing against insomnia [14].

Concerning its biological properties, *Trichilia emetica* has drawn extensive attention and has been largely investigated. Methanol extract of leaves has anti-plasmodia activity [15]. The ethanol extract is prostanglandines inhibitor demonstrating *Trichilia*'s anti-inflammatory activity [16]. The complement activating effect was investigated [17], and the antipyretic activity, by [18]. Studies of Sparg and *et al.* also demonstrated antischistosomiasis activities of this plant [19]. Hepatoprotective effect on the rats and antioxidant activity *in vitro* were investigated [20-22]. Methylene chloride extract of *Trichilia emetica* leaf presented a good antitrypanosomal activity *in vitro* on Trypanosoma bruceli [23]. Analgesic activity with pain inhibition was demonstrated with aqueous leaves extracts of *Trichilia emetica* [24].

Trichilia emetica seed oil is rich in fat and produce good quality oil used for cosmetic purposes such as in the manufacturing of natural soaps [25]. The oil is rich in essential fatty acid (palmitic, stearic, oleic and linoleic fatty acids) Essential fatty acids contribute towards maintaining a healthy skin, encourages regeneration of cells without clogging pores, has antimicrobial and anti-inflammatory properties, spreads easily on the skin hence can also be used in massage products, heals and nourishes dry cracked skin, excellent as a hair conditioner, ideal moisturizer to strengthen and softens natural hair and alleviates dry and itchy scalp. In my previous study, physico-chemical properties of seed oil, proximate composition of oilseed and biodiesel fuel production have been evaluated [26-27].

To my knowledge concerned, until now the results of minerals and fatty acid composition of seed oil produced from the *Trichilia emetica* oilseeds grown in Tepi, Ethiopia has not been published/ reported. In South Africa and other West African countries, the fatty acid composition of the seed oil has been evaluated and used in cosmetic industry. However, the adaptability of the plant to the environment causes considerable variation in the oil content, minerals contents and fatty acid composition of the oilseeds from different locations. Therefore, the present study was carried out to determine minerals and fatty acid composition of *Trichilia emetica* seed oil growing in Tepi area, South-west part of Ethiopia and evaluate its potential use in cosmetic preparations.

MATERIALS AND METHODS

Plant material: The oilseed of *Trichilia emetica* was obtained from Tepi market in south-west part of Ethiopia. Plant material was identified by Ethiopian Institute of Agricultural Research Tepi national Spice Research Center, Tepi, Ethiopia. Oilseed was transported to chemistry laboratory in polypropylene bags and kept at room temperature. The oilseed was washed with running water to remove the impurities and sun light dried.

Extraction of oil: The oilseeds from *Trichilia emetica* (250g) were dried in an oven at 105ºC and remove the external cover by hand then ground into fine powder using pistil and mortal. The oil was extracted by diethyl ether using maceration method. The solvent and oil were separated using distillation at a temperature of slightly higher than the boiling temperature of diethyl ether. The seed oil was kept in refrigerator until analysis.

Mineral analysis: The mineral contents (elements) of *Trichilia emetica* seed oil: calcium (Ca), zinc (Zn), copper (Cu), lead (Pb), Nickel (Ni), chromium (Cr) and cadmium (Cd) were determined using the atomic absorption spectrophotometer, AAS, (ZEEnit 700p, made in German) in Addis Ababa University, Department of chemistry.

Fatty acid methyl ester (FAME) preparation and analysis: Fatty acids are polar compounds and are not volatile. The evaluation of fatty acids in *Trichilia emetica* seed oil requires the preparation of fatty acid methyl esters (FAME) in order to improve volatility and to reduce peak tailing, and subsequent analysis by GC with good precision and reproducibility [28]. There are several methods for preparing the FAME from fats and oils [29-33]. In this study, the AOCS method Ce 2-66 [34] was used for the preparation of FAME, which is shown as schematic in Fig., 1.

The FAME preparations were analyzed by GC-Agilent Technologies 7820A at a temperature of 260ºC, and MS-Agilent Technologies5977EMSD a detector temperature of 280ºC, in Addis Ababa university, Department of chemistry. The mass spectra were compared with the MassHunter/Library/NIST11.L Mass Spectral Library (Table 1).

RESULTS AND DISCUSSION

The seed oil (also known as Mafura butter) is solid at room temperature. The yield of the oil is 65%

and has characteristic odor. The analysis of the mineral element composition of the *Trichilia emetica* seed oil reveals the presence of calcium, chromium, cadmium, zinc and copper while nickel and lead are below detection limit (Table 2). The most abundant element found in the seed oil is calcium with concentration of 1.668ppm. The seed oil contain low amount of zinc and copper and is not a good source of these metals.

Trichilia emetica seed oil contains palmitic acid (52.36%), oleic acid (36.7%) and linoleic acid (7.59%), stearic acid (1.99%) and cis-vaccenic acid (1.36%) (Table 3) and the chromatogram of the oil was shown in Fig., 2. While the fatty acid profile of *Trichilia emetica* seed oil reported by different scholars are: palmitic acid (43-53.0%), oleic acid (51.0%), linoleic acid (16.0), linolenic acid (16.0%), stearic acid (3.0%) [35]. The differences in individual contents of fatty acids when compared to the bibliographic references may be due to the cultivars used and to the cultivation or environmental factors [36]. Palmitic, oleic and stearic acids are synthesized in the body but linoleic acid is not and a deficiency will cause various signs. The skin dries out and becomes scaly, nails crack, and hair loss as well as transepidermal water loss increases. Linoleic acid is the most frequently used fatty acid in cosmetic products as it moisturizes the skin, aids in the healing process of dermatoses and sunburns. Oleic acid is reported to be an effective percutaneous absorption enhancer. It markedly enhanced the penetration of tenoxicam, a non-steroidal anti-inflammatory drug by as much as 15% and is reported to increase diffusivity and partitioning as well as the fluidity and flux by interaction with subcutaneous lipids [37]. Another study investigated the permeation enhancing effects of various fatty acids using diclofenac as a model drug. Of the unsaturated fatty acids, oleic acid exhibited the best permeation enhancing effect, while amongst the saturated fatty acids; palmitic acid had the most potent skin permeation enhancing effect [38]. The oil is a central part of Southern African domestic life and is renowned for its cosmetic and healing properties. It is used on the skin to nourish and revitalize as well as to condition the hair [39]. In Ethiopia, the seed oil is not used in domestic, cosmetic and hair condition due to the lack of information regarding to the benefit oil and `fear of its toxicity. Therefore, the findings of this research fill the information gaps. However, further pharmacology research will be necessary in seed oil before applying the product to human beings.

CONCLUSION

The results of the present study revealed that palmitic acid is the major fatty acid in *Trichilia emetica* oil followed by oleic acid and linoleic acid. Its fatty acid composition predisposes it favorably for use in the manufacture of natural skin care and hair product. The amount of fatty acid in *Trichilia emetica* seed oil different from other area, this is due to soil type and climatic factor. The study has helped in filling the literature gap in this area of oil studies for Ethiopia. The oil also contains little toxic metal and seed oil used for cosmetics formulations such as in body creams, shaving soap and shampoos and maybe the other new applications.

ACKNOWLEDGEMENTS

The author profoundly acknowledges Mizan-Tepi University for financial support of this research work.

Table 1: The results of mass spectra obtained from library

Library Search Report

Data Path : D:\MassHunter\Data\Essential oil\
Data File : Trichdia.D
Acq On : 27 Jul 2015 04:56
Operator : Teshome
Sample : Trichdia
Misc :
ALS Vial : 14 Sample Multiplier: 1

Search Libraries: D:\MassHunter\Library\NIST11.L Minimum Quality: 90
D:\MassHunter\Library\demo.l Minimum Quality: 0

Unknown Spectrum: Apex
Integration Events: ChemStation Integrator - autoint1.e

Pk#	RT	Area%	Library/ID	Ref#	CAS#	Qual
1	44.441	52.36	D:\MassHunter\Library\NIST11.L			
			Hexadecanoic acid, methyl ester	119407	000112-39-0	98
			Hexadecanoic acid, methyl ester	119408	000112-39-0	98
			Hexadecanoic acid, methyl ester	119400	000112-39-0	98
2	49.617	7.59	D:\MassHunter\Library\NIST11.L			
			9,12-Octadecadienoic acid (Z,Z)-, methyl ester	139724	000112-63-0	99
			Methyl 10-trans,12-cis-octadecadienoate	139709	1000336-44-2	99
			11,14-Octadecadienoic acid, methyl ester	139715	056554-61-1	99
3	49.874	36.70	D:\MassHunter\Library\NIST11.L			
			9-Octadecenoic acid, methyl ester, (E)-	141306	001937-62-8	99
			8-Octadecenoic acid, methyl ester	141273	002345-29-1	99
			9-Octadecenoic acid, methyl ester, (E)-	141310	001937-62-8	99
4	49.995	1.36	D:\MassHunter\Library\NIST11.L			
			cis-13-Octadecenoic acid, methyl ester	141299	1000333-58-3	99
			11-Octadecenoic acid, methyl ester	141291	052380-33-3	99
			9-Octadecenoic acid, methyl ester, (E)-	141310	001937-62-8	99
5	50.627	1.99	D:\MassHunter\Library\NIST11.L			
			Methyl stearate	143130	000112-61-8	99
			Methyl stearate	143126	000112-61-8	99
			Methyl stearate	143131	000112-61-8	99

Table 2: Mineral content (ppm) of *Trichilia emetica* seed oil from Tepi area

Mineral	Content
Ca	1.668 ± 0.021
Cr	0.7061±0.005
Cd	0.0387 ± 0.009
Zn	0.0246 ± 0.010
Cu	0.0184 ± 0.009
Pb	Below detection limit
Ni	Below detection limit

Table 3: Fatty acid composition (%) of *Trichilia emetica* seed oil from Tepi area

Peak	RT(min)	Fatty acid composition	Amount (%)
1	44.41	Palmitic acid **(C16:0)**	52.36
2	49.874	Oleic acid **(C18:1)**	36.70
3	49.617	Linoleic acid **(C18:2)**	7.59
4	50.627	Stearic acid **(C18:0)**	1.99
5	49.995	Cis-vaccenic acid**(C18:1)**	1.36
		Total	100%

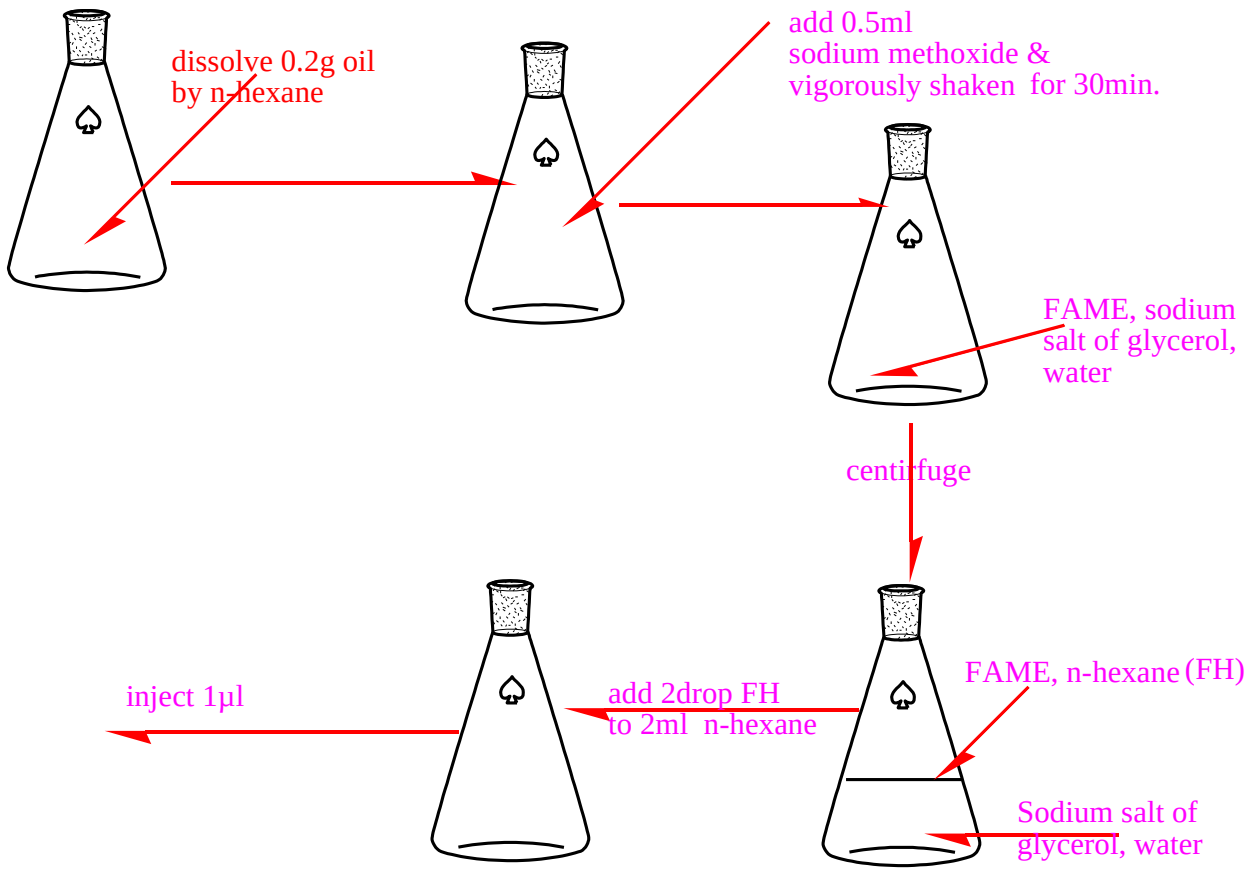

Figure 1. A schematic figure for the preparation of fatty acid methyl ester (FAME) according to AOCS method Ce 2-66

Area Percent Report

Data Path : D:\MassHunter\Data\Essential oil\
Data File : Trichdia.D
Acq On : 27 Jul 2015 04:56
Operator : Teshome
Sample : Trichdia
Misc :
ALS Vial : 14 Sample Multiplier: 1

Integration Parameters: autoint1.e
Integrator: ChemStation

Method : D:\MassHunter\GCMS\1\methods\Multi residue PESTICIDES (T).M
Title :

Signal : TIC: Trichdia.D\data.ms

peak #	R.T. min	first scan	max scan	last scan	PK TY	peak height	corr. area	corr. % max.	% of total
1	44.441	7050	7095	7128	BB 2	12919569	730976180	100.00%	52.362%
2	49.617	7954	7983	8000	BV	2635558	106000388	14.50%	7.593%
3	49.874	8000	8027	8039	VV 2	10580434	512323085	70.09%	36.699%
4	49.995	8039	8048	8072	VB 3	522295	18984477	2.60%	1.360%
5	50.627	8138	8156	8181	BB 2	721164	27713683	3.79%	1.985%

Sum of corrected areas: 1395997813

Multi resid...ICIDES (T).M Tue Aug 25 23:18:31 2015

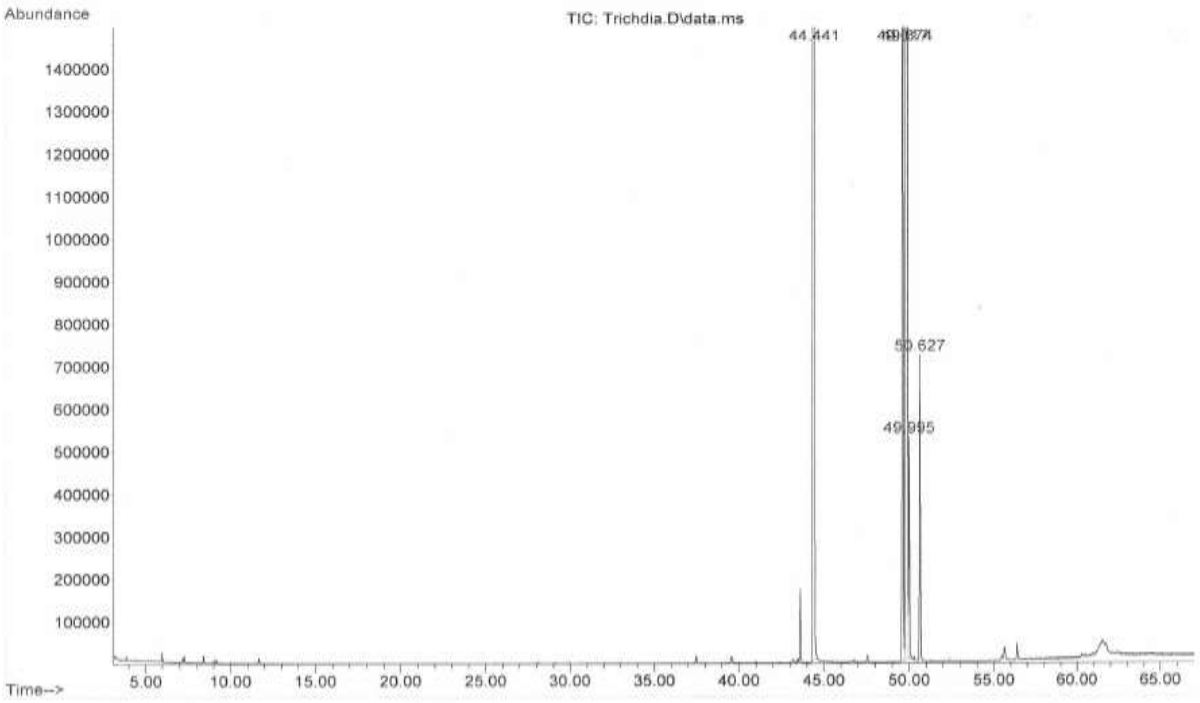

Figure 2: Chromatogram for *Trichilia emetica* seed oil

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