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Research Paper

Potential Medicinal Uses of Self-Emulsifying Crop Seed Oil: A Gas Chromatography - Mass Spectroscopy (GC-MS) Study

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Abstract. The GC-MS analysis of an extracted self-emulsifying Sudanese crop seed oil has revealed a content of a number of medicinal components that could be used to assist preventing or treating a number of diseases. Besides the oil contains a form of vitamin E, the use of which will meet appropriate dietary requirements.

Keywords: Herbal medicine, anti-bacterial, anti-inflammatory, anti-fungal, hypocholesterolemia, apoptosis.

INTRODUCTION

Due to the rising cost of synthetic drugs and their side effects, there is an increased emphasis on the uses of plant materials and extracts as a source of medicines and pharmaceutical manufacturing. This is much preferred for the reason that treatment with medicinal plants has no or minimal side effects.

Such an advantageous property and abundant natural availability have imparted a tremendous economic importance on medical herbs whose number is estimated by the WHO (World Health Organization) to be around 21000 plant species that cure several ailments. It goes without saying that the field is known as herbal medicine.

We are joining that sector calling for the return to nature and become independent of synthetics so as to be safe and secure. In our endeavor to add economic value to our Sudanese natural products (Mutasim and Khalil, 2020; Mutasim and Ibrahim, 2016, 2017; Mutasim *et al.*, 2016, 2017, 2020), we became interested in investigating and throwing light on their potentialities to assist preventing or curing some diseases.

We here report the medicinal uses potentialities of the earlier reported self-emulsifying crop seed oil (Mutasim and Khalil, 2020).

MATERIALS AND METHODS

Oil sample

The self-emulsifying oil under investigation was extracted from a Sudanese crop seeds using hexane (Mutasim and Khalil, 2020).

GC-MS analysis

Analysis of oil sample diluted in hexane (10%) was carried out using Agilent 7890 A, gas chromatograph and Agilent 5975 C inert XL EI/CI Mass spectrometer MSD coupled with a single quadrupole mass analyzer of 70 eV ionization energy. The column used is capillary HP-5MS UI (Ultra Inert) of 30m long, 0.25mm i.d., 0.25um film thickness and 5% phenyl, methylpolysiloxane stationary phase. Helium is the carrier gas with 1mL/min flow rate. Split ratio of injector split is 50 and 250ºC temperature. The oven temperature program is 50ºC for 5min, 280ºC for 20min and run time is 71min. The transfer line temperature is 250º C and the detection mode is full scan and mass range 50-1000 Da. Solvent delay is 5 min.

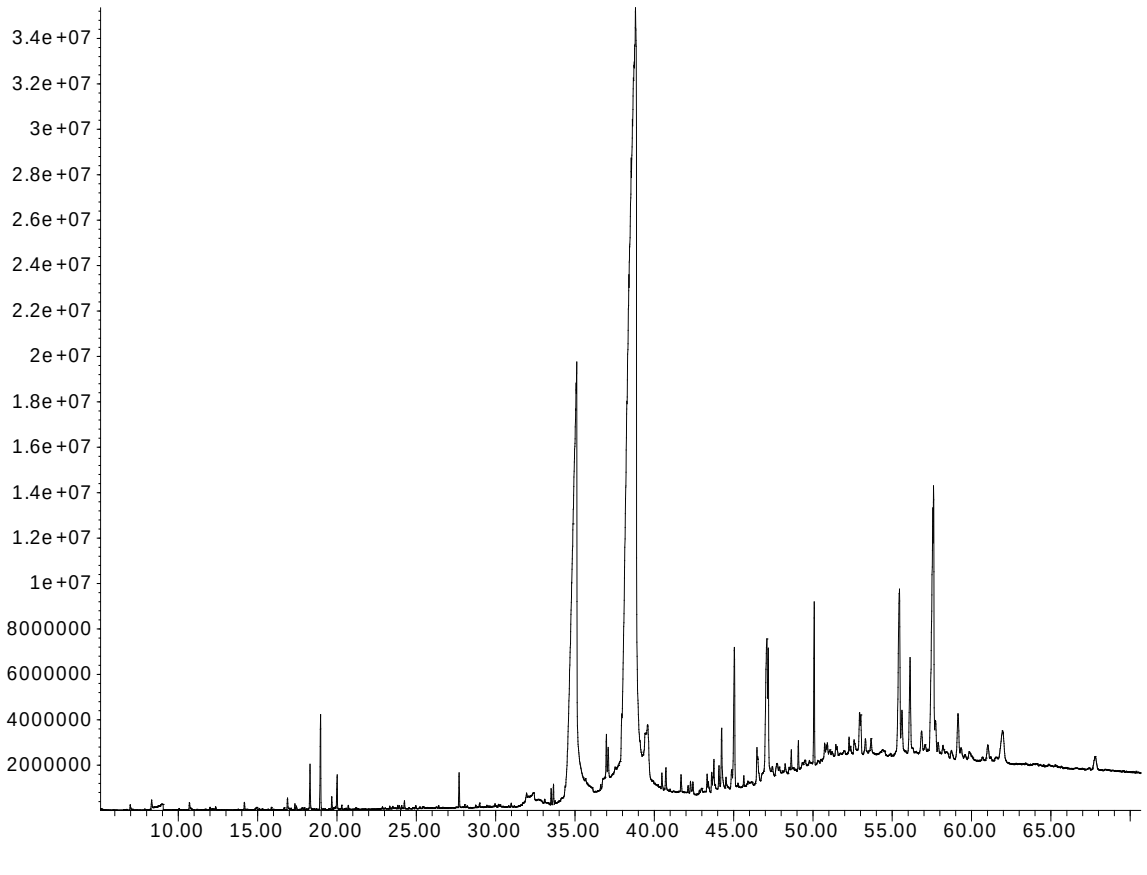

Figure 1. Chromatogram of Extracted Oil (I = Intensity).

Results and Discussion

The GC-MS analysis of the extracted oil revealed a number of components that lend such an oil as a source of medicines, dietary supplement, anti-oxidant, anti-inflammatory, anti-fungal and anti-bacterial compounds. Results are presented in Figure 1 and Table 1. Of the most appealing and interesting identified components are: n-hexadecanoic acid, $C_{16}H_{32}O_2$; linoleic acid, $C_{18}H_{32}O_2$; hexadecanoic acid, methyl ester, C17H34O2; alpha-tocopherol succinate, $C_{33}H_{54}O_5$; campesterol, $C_{28}H_{48}O$; glycidyl palmitate, $C_{19}H_{36}O_3$; and ergosterol, $C_{28}H_{50}O$. Such a number of medicinal compounds would render this oil a source of medicines that have the potentials to assist preventing or treating a group of diseases.

The most abundant components are n-hexadecanoic acid (tR 35.01 min) and linoleic acid (tR 38.82 min). Bearing in mind that one of the biggest threats to human health worldwide is the multi–drug resistant bacteria (MDR) which are becoming harder to treat as the antibiotics used to treat them become less effective, then a natural alternative is needed. This worrying fact has generated the on-going search for that natural alternative which is found in herbs and their extracts.

On one hand the saturated fatty acid n-hexadecanoic acid is known to have antibacterial and antifungal properties (Agoramoorth *et al.*, 2007). Both n-hexadecanoic and linoleic fatty acids can modulate immune responses by acting directly on T cells (Lawrence *et al.*, 1993). Vasudevan *et al.* (2012) proposed that the inhibition of phospholipase A2 is one of the ways to control inflammation. They proved and concluded from the structural and kinetic studies that the fatty acid (n-hexadecanoic acid) is an inhibitor of phospholipase A2. Hence, an anti-inflammatory compound. The polyunsaturated omega-6- fatty acid, linoleic acid, has beneficial properties that made it popular in beauty products. Skin research workers point to its anti-inflammatory, acne reduction, skin-lightening and moisture retention properties when applied topically on the skin (Ando *et al.,* 1998; Diezel *et al.,* 1993; Darmastadt *et al.*, 2002; Letawe *et al*., 1998).

We attribute the reported self-emulsifying property of the extracted oil (Mutasim and Khalil 2020) to the high concentration of linoleic acid which acts as a surfactant.

The identified hexadecanoic acid methyl ester component has the potential to act as a natural antibiotic. It has been shown that it has the highest anti-bacterial

Table 1. GC-MS Analysis Results of extracted oil.

No	tR (min)	Proposed Compound	MW	Formula
1	6.97	2-Heptenal	112	$C_7H_{12}O$
2	8.32	Furan, 2-pentyl-	138	$C_9H_{14}O$
3	10.71	2-Octenal	126	$C_8H_{14}O$
4	12.36	Nonanal	142	$C_9H_{18}O$
5	14.17	2-Nonenal	140	$C_9H_{16}O$
6	14.95	Octanoic acid	144	$C_8H_{16}O_2$
7	15.88	2,4-Nonadienal	138	$C_9H_{14}O$
8	16.88	2-Hexenyl E-2-octenoate	224	$C_{14}H_{24}O_2$
9	17.36	2-Decenal	154	$C_{10}H_{18}O$
10	17.45	3-(2-Oxocyclohexyl)propionaldehyde	154	$C_9H_{14}O_2$
11	18.30	2,4-Decadienal (E,E)	152	$C_{10}H_{16}O$
12	18.96	2,4-Decadienal (Z,Z)	152	$C_{10}H_{16}O$
13	24.27	2,4-Di-tert-butylphenol	206	$C_{14}H_{22}O$
14	27.70	Tributyl phosphate	266	$C_{12}H_{27}O_4P$
15	33.50	Butylated Hydroxytoluene	220	$C_{15}H_{24}O$
16	33.64	Hexadecanoic acid, methyl ester	270	$C_{17}H_{34}O_2$
17	35.01	n-Hexadecanoic acid	256	$C_{16}H_{32}O_2$
18	36.98	Methyl linoleate	294	$C_{19}H_{34}O_2$
19	38.82	Linoleic acid	280	$C_{18}H_{32}O_2$
20	40.48	Hexadecanoic acid, pentyl ester	326	$C_{21}H_{42}O_2$
21	40.74	Glycidyl palmitate	312	$C_{19}H_{36}O_3$
22	43.33	Pentyl linoleate	350	$C_{23}H_{42}O_2$
23	44.08	Pentacosane	352	$C_{25}H_{52}$
24	44.24	Palmitic acid β-monoglyceride	330	$C_{19}H_{38}O_4$
25	45.05	Bis(2-ethylhexyl) terephthalate	390	$C_{24}H_{38}O_4$
26	47.10	β-Monolinolein	354	$C_{21}H_{38}O_4$
27	47.18	Heptacosane	380	$C_{27}H_{56}$
28	48.63	Octacosane	394	$C_{28}H_{58}$
29	49.08	Squalene	410	$C_{30}H_{50}$
30	50.08	Nonacosane	408	$C_{29}H_{60}$
31	52.94	Stigmasta-3,5-diene	396	$C_{29}H_{48}$
32	53.03	Hentriacontane	436	$C_{31}H_{64}$
33	53.31	Cholest-5-en-3-ol	386	$C_{27}H_{46}O$
34	53.67	α-Tocopherol succinate	530	$C_{33}H_{54}O_5$
35	55.45	Campesterol	400	$C_{28}H_{48}O$
36	55.62	Ergostanol	402	$C_{28}H_{50}O$
37	56.13	Stigmasta-4,22-dien-3β-ol	412	$C_{29}H_{48}O$
37	57.60	γ-Sitosterol	414	$C_{29}H_{50}O$
39	57.74	Stigmastanol	416	$C_{29}H_{52}O$
40	61.05	2.24-Methylenecycloartanol	440	$C_{31}H_{52}O$
41	61.97	Tris(2,4-di-tert-butylphenyl) phosphate	662	$C_{42}H_{63}O_4P$

effect against pathogenic bacteria (Mohamed *et al.*, 2021). Abubacker and Deepalakshmi (2013) have reported the anti-bacterial and anti-fungal activity of the methyl ester of hexadecanoic acid extracted from *A. muricata* leaves. The extract showed that it is a significant inhibitor of growth of certain fungal strains.

Alpha–tocopherol succinate is the primary form of vitamin E which is preferentially used by human body to treat and prevent vitamin deficiency. It is reported that tocopherol succinate is ultimately de-esterified or cleaved to provide alpha-tocopherol once administered to the human body (EMEA CHAP Assesment Report, 2009). As a soluble antioxidant, it has the capability to neutralize endogenous free radicals. Such a biological action has urged researchers to study whether or not its antioxidant property may be used in preventing or treating cardiovascular disease, ocular conditions, diabetes, cancer and more. It is now proposed that the alpha tocopherol succinate compound is capable of eliciting anticancer (Edwards and Prasard, 1982; Zu and Hawthorn, 2005; Neuzil 2003; Neuzil *et al.* 2006; Tana, 2014) and inflammation mediation activities (Lee *et al.*, 2006). It might be relevant to mention that vitamin E analogues have inducing effect on apoptosis (Neuzil *et al*., 2001).

We point to the presence of the phosphate esters-tris (2, 4-di-tert-butylphenyl) phosphate and 2, 4-di-tert-butylphenol among the oil components that confirm its antioxidant property.

The identified campesterol is a phytosterol that compete with cholesterol reducing the absorption of cholesterol in human intestine and a precursor of anabolic steroid boldenone (Farquhar and Sokolow 1958; Heggen *et al*., 2010; Choudhary and Tran, 2011). It might also act directly on intestinal cells and affect transporter protein (Laura *et al*., 2008).

The glycidyl palmitate compound is known to be used for the preparation of lysophosphatic acid which inhibits apoptosis. It is proved that it might be quickly decomposed to hydrocarbons, aldehydes and carbon dioxide besides polar compounds.

More health benefits that could be obtained from this oil is manifested in the identification of the phytosterol ergostanol component that showed hypocholesterolemia and hypotriglyceridemia effects in hypercholesterolemic overweight patients. In fact there have been numerous studies on the ability of probiotics to remove cholesterol and their hypocholesterolemic effects (Patel *et al*., 2010)

Lipids such as sterols and stanols along with the unsaturated polyunsaturated fatty acids are known to be hypocholesterolemic (Lopez-Huertas, 2010). So, taking this oil will assist in the treatment of metabolic disorders. It will raise the cholesterol in the blood to the proper level in those patients suffering from hypocholeterolemia. Hence, establishing proper membrane permeability and fluidity.

Further prompted pharmacological and clinical studies are underway.

CONCLUSION

Several medicinal components have been identified in the extracted self-emulsifying oil that are beneficial to human health. According to literature survey, they could be used to assist preventing or treating a number of diseases besides being a supplement of vitamin E.

These findings generated further study and commercial promotion of the oil.

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