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Maged Zordoky

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Abstract

The following thesis is based on the analysis and effects of essential oils and extracts from five different Egyptian plants (*Nigella sativa*, *Salvia officinalis*, *Moringa peregrina*, *Salvia aegyptiaca* and *Artemisia judaica*). The essential oils and extracts were isolated from different plant parts, different growth locations and different growth phases and analyzed by GC and GC-MS. Some of the ingredients were specific for some plants and their occurrence in high percentages, have been demonstrated by several studies. *Nigella sativa* was rich in p-cymene, which is responsible for many medical properties such as antimicrobial, hepatoprotective, antiinflammatory and analgesic, gastroprotective, anticancer, immunomodulatory and antidiabetic effects. Camphor, 1,8-cineole and α-thujone were found in *Salvia officinalis* and have shown an anticarcinogenic effect in human lung cancer A549 and NCI-H226 cells. *Moringa Peregrina* has shown an antiproliferation activity by inhibiting the growth of three cancer cell lines, hepatocellular carcinoma (HepG2), breast adenocarcinoma cells (MCF-7) and colon carcinoma (HCT-116). β-Caryophyllene, bornyl acetate and selina-4,11-diene were found in *Salvia aegyptiaca*, and indicated a protective activity against liver and kidney damage. *Artemisia judaica* contained piperitone, *trans*-ethyl-cinnamate and ethyl-3-phenyl propionate which showed a significant decrease in blood glucose levels. As the medical effect of plant essential oils were positively confirmed, there are more studies that need to be done in order to explain their effects in therapy.

Zusammenfassung

In der vorliegenden Arbeit sind Studien über die Analyse und Wirkung der ätherischen Öle und Extrakte von fünf verschiedenen Ägyptischen Pflanzen (*Nigella sativa, Salvia officinalis, Moringa peregrina, Salvia aegyptiaca* und *Artemisia judaica*) beschrieben. Die Öle und Extrakte wurden aus verschiedenen Pflanzenteilen, Standorten und Wachstumsphasen isoliert und durch GC und GC-MS analysiert. Einige der Inhaltsstoffe sind spezifisch für bestimmte Pflanzen und deren Vorkommen in hohem Prozentsatz von mehreren Studien nachgewiesen. *Nigella sativa* ist reich an p-Cymol und es ist verantwortlich für viele medizinische Effekte wie antimikrobielle, entzündungshemmende sowie auch schmerzstillende, leber und magenschützende sowie anti-Tumor-Wirkung, antidiabetische und immunomodulatorische Wirkungen. Camphor, 1,8-Cineol und α-Thujon sind Hauptbestandteile in *Salvia officinalis* und zeigten eine antikarzinogene Wirkung in menschlichen Lungenkrebs-A549 und NCl-H226-Zellen. *Moringa peregrina* wurde anti proliferationsaktiv wirksam festgestellt, durch Hemmen des Wachstums von drei Krebszellinien: dem hepatozellulärem Karzinom (HepG2), dem Brust-Adenokarzinom Zellen (MCF-7) und dem Dickdarmkarzinom (HCT-116). ß-Caryophyllen, Bornylacetat und Selina-4,11-dien wurden in *Salvia aegyptiaca* gefunden und eine Schutzwirkung gegen Leber und Nierenschäden beschrieben. *Artemisia judaica* enthält als Hauptinhaltstoffe Piperiton, *trans*-Ethylcinnamat und Ethyl-3-phenylpropionat, wodurch eine signifikante Senkung des Blutzuckerspiegels erzielt wurde. Die medizinische Wirkung der pflanzlichen ätherischen Öle wurden positiv bestätigt. Es sind aber weitere Untersuchungen notwendig, damit ihre Wirkung und der Einsatz in der Therapie erklärt werden können.

Table of contents

1. Introduction

Essential oil is defined as a product obtained by hydrodistillation, steam distillation, dry distillation or by suitable mechanical process without heating (for Citrus fruits) of a plant or some parts of it. Essential oil is one of the oldest form of medicine known to man. In many ancient civilizations essnential oils were used eg. China, Greece, Egypt and India. The essential oils were considered more valuable than gold. According to ancient Egyptian hieroglyphics papyrus and Chinese manuscripts essential oils were used to heal the sick (Rubiolo P. et al., 2010).

Essential oils are aromatic oily fluids, volatile and characterized by a strong odor and rarely colorful, generally with less density than water. They can be synthesized by all plant organs (seeds, flowers, leaves, twigs, buds, bark, herbs, root and wood) thus are extracted from these parts, where they are stored in the cells, cavities, channels and cells of epidermal secretory or trichomes (Burt S., 2004; Bakkali F., 2008).

Aromatic plants are the main source of essential oils which are used as medicines, dyes, food, additives, cosmetics, insecticides and perfumes. In some African and Asian countries, 80% of the population depend on the essential oils of medicinal plants to maintain their health and treat diseases. The desire to use essential oils has increased especially when it comes to people who want an organic, simple, reliable and strong alternative to synthetic drugs in order to avoid unhealthy side effects. In the Arabian region, plants are used by the local people to treat various diseases. Therefore, folk medicinal use of plants is explained by some tribal groups in Arabian countries (World Health Organization, 2008).

This thesis offers a collection of publications, which include chemical compositions of essential oils from five different Egyptian aromatic plants. The oils were obtained by steam distillation and analyzed by gas chromatography. The second point of this thesis was to detect the effects of essential oils in studied plants. The studies used in this thesis were carried out either *in vitro* and *in vivo* on animals.

Although Egypt has a great diversity of plants and a good source of medicinal plants, its regions are far from being thoroughly explored.

2. Proposal

Essential oils definition:

Essential oils, also known as volatile oils, are concentrated natural plant products which contain volatile aroma compounds. These mixtures of volatiles compounds (mainly mono- and sesquiterpenoids, benzoids, phenylpropanoids, etc.) possess different biological properties on humans, animals and other plants (Buchbauer G., 2010).

Fatty oils definition:

An oil derived from both animals and plants. They occur in many plant families, stored frequently in large amounts in seeds, fruits, tubers, stems and other plant organs. Four classes of plant fatty oils are drying oils, semi drying oils, non drying oils and fats or tallows. Fatty oils are fixed oils because they do not evaporate or become volatile. Fatty oils are liquid at room temperature and insoluble in water but soluble in several organic solvents and usually contain oleic acid. Fatty oils contain glycerin in combination with a fatty acid. They can not be distilled without being decomposed (Farlex Partner Medical Dictionary © Farlex 2012).

Extract oil definition:

Oil is extracted from several seeds, nuts and fruits for use in cooking and soapmaking, cosmetics, detergents or as an ingredient in other foods such as baked or fried goods. Oil extraction methods are manual presses, ghani, expeller and solvent extraction.

3. Plant species

3.1. *Nigella sativa* L.

Figure 1: *Nigella sativa* L.
(Adapted from: www.getwellnatural.com, December 2015)

3.1.1. Taxonomy

Kingdom:	Plantae
Subkingdom:	Tracheobionata
Supervision:	Spermatophyte
Order:	Ranunculales
Family:	Ranunculaceae
Genera:	Nigella
Species:	N. sativa

3.1.2. Occurrance and morphology

Nigella sativa L., known as black seed or black cumin, belongs to the Ranunculaceae family. It is a genus of about 14 species of annual plants and is native to Mediterranean countries, Middle East, Eastern Europe and Western Asia. *N. Sativa* is a small prostrate annual herb, about 45 cm high, with 2-3 slender leaves, 2-4 cm long cut into linear segments, segments oblong. The flowers are delicate, white, yellow, pink, pale blue or pale purple with 5-10 petals. The fruit has a large inflated capsule composed of 3-7 united follicles with a pungent bitter taste and a faint smell of strawberries. Each of the follicles contains numerous seeds. The seeds are trigonous black or brown in colour, usually

three-cornered, with two flat sides, one convex and have a strong agreeable aromatic odour, similar to nutmeg with a spicy and pungent taste (Varghese E., 1996; Dwivedi S.N., 2003).

Nigella sativa has medicinal value worldwide and is known under various names (Table 1).

Table 1: Some of the names given to *Nigella sativa* in different languages (Nandkarni K.M., 1982; Pullaiah T., 2006).

Arabic	Habbatul Sauda, Kabodan . Kamun Aswad, Shoneez
Bengali	Kala Zeera, Mangrela
English	Small Funnel, Black Cumin
German	Schwarzkümmel
Gujrati	Kalaunji Jirum, Kadujeeroo
Hindi	Kalonji, Kalajira, Mangraila
Kannada	Karijirige
Kashmiri	Tukhme Gandana
Marathi	Kalaunji-jire, kalerjire
Malyalam	Karinchirakam
Panjabi	Kavanji
Persian	Shoneez, Siyah Dana
Sanskrit	Susavi, Krishna jiraka, Upakuncika, Karvi, Sthula Jiraka
Sindhi	Kalodi
Tamil	Karunjarakam, Karunjiragam
Telgu	Peeajila Kara, Nallajilakara
Turki	Qarachurak Audi
Urdu	Kalonji
Unani	Sino, Sheenon, Kamaazaruus

3.1.3. Chemical composition

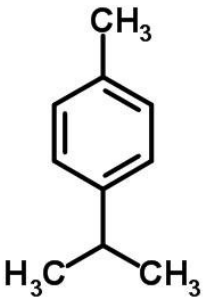
Nigella sativa has a wide range of medicinal uses, suggested from many phytochemical studies. In the study of Hajhashemi et al. results showed that the *N. sativa seeds* contained 28 to 36% fatty oil, alkaloids, proteins, saponins and 0.4 to 2.5% essential oil. The fixed oil contained saturated and unsaturated fatty acids. Unsaturated fatty acids were mainly composed of linolenic, oleic, eicosadienoic and arachidonic acids. The saturated fatty acids were palmitic, stearic and myristic acids (Hajhashemi et al., 2004).

In the study of Toma et al. the fatty acids composition of *N. sativa* oils was analyzed by using GLC (Gas-Liquid Chromatography). The plants were collected from the Nabeul and Menzel temime regions (Northeast of Tunisia). The extracted fatty oil consisted of 15.56% saturated fatty acids, 19,87% monounsaturated fatty acids and 64.48 % polyunsaturated fatty acids.

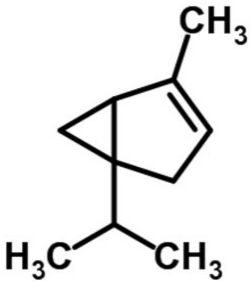
The following saturated fatty acids were found in *N. Sativa*: Myristic acid (C14:0) 0.14%, palmitic acid (C16:0) 8.92%, stearic acid (C18:0) 2.44%, arachidonic acid (C20:0) 0.13%, behenic acid (C22:0) 2.89% and lignoceric acid (C24:0) 1.04%. Palmitoleic acid (C16:1) 0.18%, oleic acid (C18:1) 19.42% and eicosanoic acid (C20:1) 0.27% were identified as monounsaturated fatty acids. Linoleic acid (C18:2) 63.71%, linolenic acid (C18:3) 0.44% and eicosadienoic acid (C20:2) 0.33% were identified as polyunsaturated fatty acids. Results showed that linoleic acid (C18:2) was a major component containing 63.1% of the total fatty acids (Toma C.R. et al., 2013).

Ghosheh et al. and Hajhashemi et al. analyzed the chemical composition of the essential oils present in the seed of *N. sativa* by gas chromatography-mass spectrometry (CG / MS). In both studies, many components were determined but the pharmacologically active constituent of volatile oil were thymoquinone, dithymoquinone, thymol and thymohydroquinone which have been identified as the main components (Ghosheh et al., 1999; Hajhashemi et al., 2004).

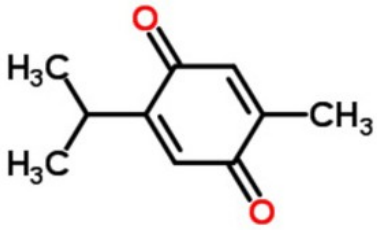
In the study of Ainane et al. the chemical composition of essential oils of *N. sativa* was also examined. The study was carried out in Morocco. The essential oils were obtained by steam distillation from the seeds and were analyzed by gas chromatography using a flame ionisation detector. The main components were p-cymen 60.5%, α-thujen 6.9%, γ-terpinene 3.5%, thymoquinone 3.0%, carvacrol 2.4%, β-pinene 2.4%, terpinene-4-ol 2.1%, α-pinene 1.7% (Table 2) (Ainane T. et al., 2014).



p-cymene



α-thujene



thymoquinon

Figure 2: The structures of some *N. sativa* ingredients (Graphics created with Chemspider).

Table 2: Percentages of chemical compositions of the *N. Sativa* essential oil (Ainane T. et al., 2014).

Compd.	Percentage
α-thujene	6.9%
1,8-cineol	0.1%
α-pinene	1.7%
γ-terpinene	3.5%
sabinene	0.9%
terpinen-4-ol	2.1%
β-pinene	2.4%
p-cymen-8-ol	0.2%
myrcene	0.1%
thymoquinon	3.0%
α-terpinene	1.0%
carvacrol	2.4%
p-cymene	60.5%
longifolene	0.9%
limonene	1.4%
thymohydroquinone	0.4%

The volatile oil of *N. sativa* seeds contained other constituents such as p-cymene, carvacrol, t-anethole, 4-terpineol and longifoline. Results showed that the crystalline active principle nigellone is the only constituent of the carbonyl fraction in the oil. The same authors also found that *N. Sativa* seeds had four alkaloids, which have been identified as nigellicine and nigellidine (Atta-ur-Rehman S., 1985a, b, 1995).

An investigation lead by Merfort et al. showed that the ethanolic extract from *N. sativa* seeds contained three flavonoids, namely quercetin, kaempferol 3-glucosyl (1-2) galactosyl (1-2) glusoside and quercitin–3-(6-ferulolyl glucosyl) (1-2) galactosyl (1-2) glucoside (Merfort et al., 1997).

In the study of Haq et al. results showed that the extract of *N. sativa* seeds contained other ingredients including nutritional components such as vitamins, carbohydrates, mineral elements, fats and proteins which included many essential amino acids. By using sodium dodecyl sulfate polyacrylamide gel electrophoresis (SDS-PAGE) in fractionation of *N. sativa* seeds showed bands ranging from 94 to 100 KDa molecular mass (Haq et al., 1999). Recently, the study of Al-Bahtiti described the nutrient and mineral contents of *N. Sativa* (Table 3) (Al-Bahtiti, 2015).

Table 3: Parameters (g/100 g dry weight basis) of nutrient and mineral contents of *N. sativa* seeds (Al-Bahtiti, 2015).

Moisture	5.2 ± 0.3
Lipid	36 ± 0.4
Ash	4 ± 0.3
Total protein	18.8 ± 0.3
Water soluble protein	5.5 ± 0.3
Starch	4.0 ± 0.3
Crude fiber	5.2 ± 0.3
Total sugar	1 ± 0.2
Total carbohydrate	30
Calcium	611 ± 3
Copper	4.8 ± 0.4
Iron	11.2 ± 0.3
Zinc	6.2 ± 0.3
Potassium	802 ± 2.3
Magnesium	80.2 ± 0.2
Phosphorus	118 ± 2.2
Sodium	280 ± 1
Manganese	1.4 ± 0.2

Monosaccharides from *N. sativa* were found in the form of glucose rhamnose, xylose and arabinose. The seeds contained carotene, which is converted to vitamin A by the liver, and considered a good source of calcium, iron and potassium (Salem et al., 2000).

In the study of Ramadan and Morsel results showed that the total sterols percentage of *N. Sativa* seed oil were as follows: cholesterol 0.88%, campesterol 13.1 %, Δ5-avenasterol 12.4%, Δ7-avenasterol 2.1%, β-sitosterol 49.41% and stigmasterol 17.8% as major sterols (Table 4) (Ramadan and Morsel, 2002).

Table 4: Sterol composition of the *N. sativa* seeds oil (Ramadan and Morsel, 2002).

Sterols	% of total sterols
Cholesterol	0.88 ± 0.1
Beta Sitosterol	49.4± 0.1
Delta 5 avenasterol	12.4± 0.1
Campesterol	13.1± 0.1
Delta 7 stigmasterol	0.64± 0.1
Stigmasterol	17.8± 0.1
Delta 7 avenasterol	2.11± 0.1

3.1.4. Effect and application

Nigella sativa has been used in the Middle East, Africa and Asia for medicinal purposes for centuries, both as a herb or pressed oil. In the study of Dwivedi results showed *N. sativa* extract seed oil in Tutankhamun's tomb, as well as many sites from ancient Egypt, which showed few archeological evidence about the earliest cultivation. It is well known that ancient Egyptians carefully chose the seeds, which were entombed with the Pharaoh to assist him in the after life (Dwivedi S.N., 2004).

N. sativa seeds been traditionally used for a variety of conditions and treatments in the Middle East and Southeast Asian countries, as food and as medicine. The seeds and their extract oil have been traditionally used to treat a number of diseases such as bronchitis, asthma, rheumatism and related inflammatory diseases. A flavouring agent found in the seed extract oil promotes digestion and fights parasitic infections and increases milk production in nursing mothers. *N. sativa* extract oil has also been used to treat skin diseases, such as eczema, boils and for treating flu symptoms. It is

sometimes used to preserve woollen fabrics from insect damage by scattering them in the folds. The Arabic approbation 'Habbatul barakah', means "the seed of blessing" (Dwivedi S.N., 1999; Dwivedi S.N. et. al., 2007).

In the studies of Warrier et al. and Sharma et al. traditional uses of *N. sativa* seeds were mentioned and the seed essential oil was considered aromatic, bitter, appetizer, digestive, stimulant, pungent, purgative, constipating, abortifacient, anthelmintic, carminative, diuretic, emmenagogue, local anesthetic, galactagogue, acrid, thermogenic, anodyne, deodorant, sudorific, febrifuge and expectorant. It also has been used to treat several diseases such as cough, fever, flatulence, dysentery, ascites, jaundice, hydrophobia, paralysis, conjunctivitis, piles, skin diseases, dyspepsia, anorexia, amenorrhea, abdominal disorders, diarrhea, and intrinsic hemorrhage (Warrier et al., 2004; Sharma et al., 2005).

Antimicrobial activity

Nigella sativa essential oil has shown to have strong antimicrobial activity aganist many microbial infections such as *Salmonella typhi*, *Pseudomonas aeruginosa* and others. Also the oil has high activity against Gram-positive and Gram-negative microorganisms such as *Staphylococcus aureus*, *Vibrio cholerae*, *S. pyogenes, S. viridans* and *E. coli*. In an *in-vitro* study, volatile oil had more antibacterial activity in comparison to ampicillin, which also extended to drug-resistant strains of *Shigella spp*, *E. coli* and *Vibrio cholerae*. It also showed a synergistic effect with streptomycin and gentamycin (Chopra et al., 1958; Satyanarayana et al., 1975).

An old study of Bauer and Kirby showed antimicrobial activity of the *N. sativa* volatile oil which was determined by the disc diffusion method. The results are presented in Table 5. The order of strength in antimicrobial activity was Gram-negative bacteria followed by Gram-positive bacteria, yeast and dermatophyte. 20 mg of volatile oil contributed to antimicrobial activity, due to the presence of biological active compounds such as thymoquinone, α-pinene, α-thujene, 2(1H)-naphthalenone, α-phellandrene, limonene and myristicin, which lead to decrease of some resistant microorganisms such as *Trichophyton mentagrophytes*, *Tricoderma vibriae*, *Penicilliumrubrum* to *N. sativa* oil (Bauer and Kirby, 1966).

Table 5: Antimicrobial activity of the *N. sativa* volatile oil by disc diffusion method (Bauer and Kirby, 1966).

Microorganisms		Inhibition Zone in mm	
		Oil disc (20mg)	Standard
Gram-Positive Bacterial species:			
Staphylococcus aureus	MTCC 737	18	25
Streptococcus pneumoniae	MFBF	14	nt
Bacillus subtilus	MTCC 121	10	nt
Micrococcus luteus	MTCC 1541	11	20
Gram-Negative Bacterial species:			
Pseudomonas aeruginosa	MTCC 1688	14	11
E. Coli	MTCC 1687	14	17
Vibrio cholerae	MFBF	16	nt
Salmonella typhi	MFBF	10	nt
Proteus vulgaris	MTCC 1771	12	12
Haemophilus influenzae	MFBF	32	nt
Neisseria gonorrhoeae	MFBF	18	nt
Klebsiella pneumoniae	MFBF	16	16
Yeast :			
Candida albicans	MTCC 18	8	12
Fungi:			
Aspergillus niger	MTCC 1344	10	13
Aspergillus flavus	MFBF	09	14
Tricoderma vibriae	MFBF	0	16
Penicillium rubrum	MFBF	0	16
Chaetomium globosum	MFBF	07	12
Dermatophyte:			
Trichophyton mentagrophytes	MFBF	0	12

nt=not tested; clindamycin 2mg/ml for S.aureus, gentamicin 2mg/ml for Ps. aeruginosa, Proteus vulgaris; tetracycline 3mg/mlE.Coli and B.subtilus clotrimazole 5mg/ml for C. albicans; nystain 10mg/ml for A.niger and T.mentagrophytes.MFBF: number of strains from the collection of microorganisms of the Dept. Of Microbiology and biotechnology, Anantapur. MTCC: Microbial type culture collection centre.

Hepatoprotective activity

Nigella sativa is reported to have hepatoprotective activity due to a presence of thymoquinone which is considered one of the more active constituent. The activity was demonstrated by a decreased leakage of aspartic transaminase, alanine transaminase and decreased trypan blue uptake. An *in-vitro* study showed the protective effect against tert-butyl hydroperoxide which induced oxidative damage to hepatocytes (Chopra et al., 1958; Satyanarayana et. al., 1975). Thymol, one of the constituents of *N. sativa* seeds, exerted a hepatoprotective effect on chemical induced hepatotoxicity in rodents (Janbaz K. et al, 2003). Another study found that the *N. sativa* essential oil had protective effect against carbon tetrachloride and D-galactosamine which induced hepatic toxicity in rats due to increased serum activities in glutathione reductase and decreased of aspartic transaminase, alanine transaminase, malate dehydrogenase, alkaline phosphatase and lactate dehydrogenase (El-Dakhakhany et al., 2000). Significant hepatoprotective activity has been reported aganist toxic metals such as lead and attenuated hepatic lipidperoxidation, following exposure to chemicals such as carbon tetrachloride (Farrag A.R. et al., 2007). Nagi et al. found that the hepatoprotective activity of thymoquinone was compared with that of silybin which acts as a hepatoprotective agent. It was found that *N. sativa* oil had protective effects against carbon tetrachloride and D-galactosamine and had no hepatic injury with pretreatment of mice for four weeks. In the adminstration of thymoquinone, 8 mg/kg/day for five days before and one day after carbon tetrachloride treatment, it was found that *N. sativa* protected against biochemical and histological markers of hepatic damage (Nagi et al., 1991).

Antiinflammatory and Analgesic activity

Nigella sativa essential oil and thymoquinone have shown to have an antiinflammatory effect aganist chronic inflammatory disorders involving a variety of inflammatory mediators and different pathways such as asthma and arthritis. Due to inhibition of eicosanoid generation in leucocyte and membrane lipid peroxidation, a significant reduction in granuloma pouch weight reduction and in rat paw oedema was observed. Also for nigellone, which is one of the active constituents, an antiasthmatic effect by inhibiting the histamine release from the mast cells in low concentrations was found (Chopra et al., 1958; Satyanarayana et. al., 1975). In the study of Swamy at el. reports showed that the analgesic effect of *N. Sativa* oil had an active principle thymoquinone, which caused inhibition of cyclooxygenase and 5-lipooxygenase pathways (Swamy S. at el., 2000). In another study, results showed that the aqueous extract of *N. sativa* had anti-inflammatory effects which might have been partly through inhibition of nitric oxide production (Mahmoud M. et al.,

2003). Polyphenols from the *N. sativa* seeds caused analgesic and anti-inflammatory effects which were studied in rats and mice using acetic acid-induced writhing, formalin, light tail flick, carrageenan croton oil-induced ear edema and induced paw edema tests (Ghannadi A. et al., 2005).

Gastroprotective activity

N. sativa was used for stomachache, as a carminative, digestive, anti-jaundice and laxative (Gilani A. et al., 2004). *N. sativa* alcoholic extract had antiulcer activity in pyloric ligation and in aspirin-induced gastric ulcer models (Rajkapoor B. et al., 2002). *N. sativa* has shown gastroprotective activity aganist ethanol which had an ulcerative effect on gastric mucosa by decreasing the level of glutathione-S transferases in gastric mucosa (Kanter M. et al., 2005). The study of Randhawa M. et al. showed that the *N. sativa* seeds contained an aqueous-methanolic extract which had a spasmolytic effect mediated through the calcium antagonist effect, thus explaining scientific causes for its traditional use in diarrhea (Randhawa M. et al., 2002). In another study, thymoquinone given in small dose (5 mg/Kg) was found to give partial protection, but higher doses (10 mg/Kg) were found to give complete protection aganist colitis which was induced by acetic acid in rats. The possible mechanism of the protective effects might be partly due to an antioxidant impact (Mahgoub A., 2003). An old study of Mahfouz and El-Dakhakhany reported that oral dosage of *N. sativa* powder relieved flatulence due to the presence of nigellone, thymoquinone, thymohydroquinone and dithymoquinone by means of histamine antagonistic effect, thus inducing contractions in guinea pig intestines. In addition to this, a choleretic effect of *N. sativa* extract oil was found (Mahfouz and El-Dakhakhany, 1960).

Cardiovascular activity

N. sativa seeds were used in Arabian folk medicine, in combination with or without honey or garlic for hypertension treatment (Randhawa M. et al., 2002). *N. sativa* extract lowered blood pressure in dogs (El-Zawahry B. et al., 1964). Another study showed that oral doses of 0.6 ml/kg/day of *N. sativa* extract gave a significant hypotensive effect in spontaneously hypertensive rats. These results were significantly comparable with the standard anti-hypertensive drug nifedipine (Zaoui A. et al., 2002). *N. sativa* essential oil had an antihypertensive effect due to diuretic action (Zaoui A. et al., 2000).

In the study of El-Tahir et al. results showed that *N. sativa* volatile oil and thymoquinone decreased arterial blood pressure and heart rate. These effects significantly antagonized with atropine, cyproheptadine and hexamethonium (El-Tahir K. et al., 1993). Given *N. sativa* extract for a two-months dietary supplementation, normal rats showed a homogenous cardiac hypertrophy and enhanced cardiac contractility at baseline conditions (Yar et al., 2008). *N. sativa* seeds extract were administered orally in several animal models which showed promising lipid lowering activity. It significantly reduced the serum lipoprotein and cholesterol level (Le P.M. et al., 2004). The studies of Inayat et al. and Datau et al. showed that *N. sativa* seed powder had a significant anti-hyperlipidemic activity in humans by administering the seeds before breakfast for two months. Results showed a reduction in the total cholesterol, triglycerides and LDL-cholesterol levels (Inayat et al., 2009; Datau et al., 2010).

Anticancer activity

Methanolic extract of *N. sativa* seeds exhibited strong cytotoxic action in Elrich ascites carcinoma, Dalton's ascites lymphoma and sarcoma 180 while exerting minimal cytotoxicity to the normal lymphocytes (Salomi et al., 1992). In an *vitro* study Farah and Begum examined *N. sativa* aqueous and alcoholic extracts with or without H2O2 as an oxidative stressor. The results showed an inactivation of MCF-7 breast cancer cells (Farah and Begum, 2003). In some investigations, the anticancer effect of thymoquinone and β-elemene of *N. sativa* seeds was studied on mice both *in vivo* and *in vitro*, induced on fibrosarcoma by 20-methyl cholanthrene. Results showed a significant anti tumor effect. The possible mechanism of action was discussed to be based on the antioxidant effect and interference with DNA synthesis coupled with enhancement of the detoxification process (Badary and Gamal-el-Din, 2001; Zhou et al., 2003; Gali-Muhtasib et al., 2006; Amr, 2009). Results showed that thymoquinone exhibited antineoplastic activity against prostate cancer cells by blocking G1 phase prostate cancer cells from entering the S phase thus proving to be useful in prostate cancer treatment. Thymoquinone showed significant anticaner activity against human colon cancer through cellular destruction and interference of cellular metabolic functions of SW 626 human colon cancer cells, which was comparable to the effect of 5 flurouracil (Kaseb O. et al., 2007).

Immunomodulatory activity

It was found that the people who took *N. sativa* seeds or seed extract oil as a natural remedy or as a prophylaxis aganist common cold and asthma showed improved health status (El-Kadi et al., 1986).

In the study of Omar A. et al. human volunteers were given 1gm of *N. sativa* twice daily. Enhanced immune functions were manifested by 72% increase T helper cell (T4) to T suppressor cell (T8) ratio and an improvment of natural killer cell activity. However, there was a decrease in immune globulin (IgA, IgG and IgM) levels (Omar A. et al., 1999). Another study showed that *N. sativa* seeds had activated human lymphocytes to produce interleukin-3, interleukin1B, cytokines and tumor necrosis factor-α when cultured with pooled allogenic cells or without any added stimulator. Interleukin-1β increased suggesting that *N. sativa* had an effect on macrophages as well (Haq A. et al., 1995). Authors also noted that some proteins of *N. sativa* had suppressive and others had stimulatory properties in lymphocyte culture depending upon the donor and the concentration used (Haq A. et al., 1999).

Antidiabetic Activity

N. sativa showed significant hypoglycaemic activity which is thought to be due to the essential oil. Clinical studies have confirmed these results and suggest an antidiabetic action in the plant extract (Al-Awadi and Gumma, 1987).

The glucose lowering effect of *N. sativa* was noted in rats when used in a mix containing myrrh, gum, asafoetida and aloe (Al-Awadi and Gumma, 1987). *N. sativa* volatile oils had a significant antidiabetic impact on normal and alloxan-induced diabetic rabbits without changes in insulin levels (Al-Hader A. et al., 1993). In the study of Basoma O. results showed that the *N. sativa* seeds caused a significant reduction in fasting blood glucose (FBG), 2-hour glucose plasma glucose (2hPG) and glycated haemoglobin (Hba), when administered orally in human volunteers in a dose of 2mg/day for three months as adjuvant therapy. It showed glucose lowering effects without significant change in body weight. An increase in pancreatic beta-cell function was shown after 12 weeks of treatment (Basoma O., 2010). Another study of *N. Sativa* essential oil on 60 diabetic patients showed a significant improvement in fasting blood glucose, total cholesterol and low density lipoprotein cholesterol (LDL-C) indicating an effective therapy in patients who had an insulin resistance syndrome (Najmi et al., 2008).

3.2. *Salvia officinalis* L. (sage)

Figure 3: *Salvia officinalis* L

(Adapted from: www.Floristtaxonomy.Com, December 2015)

3.2.1. Taxonomy

Kingdom:	Plantae
Order:	Lamiales
Family:	Lamiaceae
Subfamily:	Nepetoideae
Genus:	Salvia
Species:	officinalis

The derivation of the name

The name of the genus *Salvia* is derived from the Latin word salvere, which means "to save" in reference to the curative properties of the plant, which was in olden times celebrated as a medicinal herb. This name was corrupted popularly to Sauja and Sauge (the French form), in old English Sawge, which is known today as sage (Grieve, 1984).

The genus *Salvia* belongs to the family Lamiaceae (formerly Labiatae). The genus was divided into four subgenera: *Salvia, Sclarea, Leonia* and *Calosphac* (Bentham et al., 1876). It is an impotant genus which consists of more than 900 species. *Salvia* has been cultivated worldwide for the use in folk medicines and to provide a source of medically valuable essential oils and secondary metabolites. The genus *Salvia* is an important area of interest for chemists because of its medical importance and the chemical composition of their species (Gorai et al., 2011; Lu and Foo, 2002). In

Egypt, the genus *Salvia* is represented by ten species eg. *Salvia officinalis* and *Saliva aegyptiaca* (Tackholm V., 1974).

3.2.2. Occurrance and morphology

Salvia officinalis L., sage, garden sage or common sage is the most representative species within the genus of Lamiaceae family. The plant is mostly diffused in the Mediterranean regions, in South East Africa and in Central and South America, and is being currently cultivated in various countries for culinary and medicinal purposes. It is a perennial low evergreen shrub with woody stems, grayish leaves, and blue to purplish flowers (Mirjalili et al., 2006; Raal et al., 2007).

3.2.3. Chemical composition

Several phytochemical investigations have been carried out on *S. officinalis.* Terpenoids and phenolics are considered as one of the major chemical classes of secondary metabolites in the plant. The terpenoids and the volatile oil are produced in aerial parts of *S. officinalis*. Both are used in a wide range of applications, in the food industry and in aromatherapy. *S. officinalis* is considered to contain the highest amount of essential oils compared to any other species (Giannouli A.L.et al, 2000; Dweck A.C., 2000).

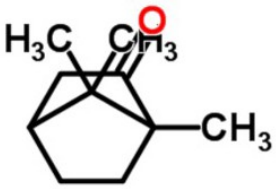
In the study of Boszormenyi et al. the chemical composition of *S. officinalis* essential oil has been investigated in various countries. It was shown that the essential oils, according to the amount of the major constituents, were divided into five groups (Boszormenyi et al., 2009):

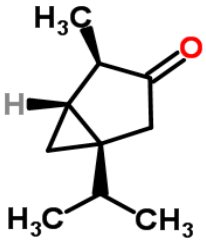
1. 1,8-cineole > camphor > α-thujone > β-thujone
2. β-thujone > camphor > 1,8-cineole > α-thujone
3. camphor > α-thujone > 1,8-cineole > β-thujone
4. α-thujone > camphor > β-thujone > 1,8-cineole
5. camphor > α-thujone > β-thujone > 1,8-cineole

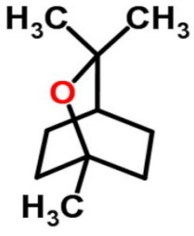
Several studies have reported significant specific variations in the concentration of the major compounds of *S. officinalis* essential oil depending on the geographical origin (Table 6).

Table 6: The major compounds of *S. officinalis* L. essential oils depending on the geographical origin.

Geographical region	Major compounds	Concentration%	References
Albania	α-thujone	12.2-49.3	
	β-thujone	3.1-10.5	Asllani, 2000
	camphor	13.7-37.8	
	1,8-cineole	3.9-23.4	
Algeria	α-thujone	24.52	Lakhal et al., 2013
	1,8-cineole	15.92	
	camphor	16.86	
	β-thujone	6.5	
Italy	β-thujone	2.06 - 7.41	Russo et al., 2013
	camphor	8.4–20.8	
	α-thujone	7.8–20.1	
	borneol	12.5–16.9	
Egypt	camphor	25.11	Jirovetz et al., 2006
	α-thujone	22.19	
	β-thujone	17.70	
	1,8-cineole	7.45	
Tunisia	1,8-cineole	29.41	Hamrouni-Sellami et
	α-thujone	22.58	al., 2012
	camphor	20.22	
Libya	camphor	27.3	Awen et al., 2011
	α-thujone	24.3	
	1,8-cineole	16.5	
Siria	1,8-cineole	62	Khalil et al., 2011
	camphor	8	
	β-pinene	6	
Morocco	*trans*-thujone	29.84	Bouajaj et al., 2013
	1,8-cineole	6.82	
	camphor	9.14	
Jordan	1,8-cineole	55-60	Abu-Darwish et al.,
	camphor	9-10	2013
	α-pinene	3-4	







camphor α-thujone 1,8-cineole

Figure 4: Chemical structure of the main components of *S. officinalis* essential oils (Graphics created with Chemspider).

In the study of Hussein S. et al. the chemical composition of essential oils of *Salvia officinalis* grown in Egypt was examined. The study was carried out in Egypt. The essential oils were obtained by steam distillation from the fresh herbs and analyzed by GC/MS. The main components were camphor (26.38%), 1,8-cineole (17.83%) and α-thujone (13.82%). Other important compounds were β-thujone (5.96%), manoyl oxide (5.46%), humulene (4.59%), caryophyllene (3.86%), γ-selinene (3.73%), limonene (3.54%), borneol (3.06%), α-terpinylacetate (2.02%), α-terpineol (1.50%), caryophyllene (I3) (1.10%), caryophyllene oxide (1.06%) and humulene epoxide (1.02%). The values can be seen in Table 7 (Hussein S. et al., 2015).

Table 7: Principal constituents of *Salvia officinalis* essential oil (Hussein S. et al., 2015).

Compound	%
limonene	3,54
myrtenol	0,26
1,8-cineole	17,83
carveol	0,10
linalool	0,20
ledol	0,95
α-thujone	13,82
γ-selinene	3,73
β- thujone	5,96
caryophyllene oxide	1,06
β-pinene	0,27
santolina triene	0,19
caryophyllene	3,86
spathulenol	0,47

γ-elemene	0,20
humulene epoxide	1,02
(Z)-pinocamphone	0,31
myristicin	0,13
camphor	26,38
isoaromadendrene epoxide	0,31
humulene	4,59
α-santalol	0,11
camphene	0,25
trans-Z- α- bisabolene epoxide	0,25
α-terpineol	1,50
caryophyllene (I3)	1,10
borneol	3,06
manoyl oxide	5,46
α-terpinyl acetate	2,02
β-selinene	0,45
geranyl acetate	0,21
Total identified compounds	92,45

3.2.4. Effect and application

Salvia officinalis L. is used as a herbal medicinal product since the very early times and is still widely used today. An infusion of dried plant leaves with boiling water (sage tea) is the most typical form of preparation (Dweck A.C., 2000).

It has antihydrotic and perspiration–inhibiting effects when taken as a tea, its effect starts after about two hours and may last for several days after drinking it (Fluck H., 1988; LeungA.Y., 1989; Lust L., 1986). This effect may be caused by the depressing fever control center in the brain and also by relieving spasms in the smooth skeletal muscle (Winter-Griffith H., 1988). *S. officinalis* L. tea is made of either dried or fresh leaves. It has a quick effect on excessive sweating, by taking one cup in small doses each day, it had a calming effect on sweat glands and effectively reduced outbreaks of sweat whether they occured in the underarm area, on hands, feet or the entire body (Ayensu E., 1981).

S. officinalis essential oil can be used as treatment of menopausal hot flushes, which was proved by a multicentre open clinical trial (Bommer et al., 2009).

S. officinalis extract was also used as a spasmolytic, carminative, astringent, antiseptic, and is used in a variety of complaints as inflammation of the mouth, throat and tongue as a mouthwash or gargle (British Herbal Pharmacopoeia, 1983). It has been used for inflamed and bleeding gums and for mouth ulcers (Hoffman D., 1987). It has bactericidal activity: results showed relief and promoted healing of peritonsillar abscesses by gargling which needs to be hot and repeated every two hours (Weiss R.F., 1986). de Bairacli Levy found that a mixture of *S. officinalis* leaves and commen sea salt, blended together and baked until hard, can be used as a tooth-powder (stain remover) (de Bairacli Levy, 1991).

S. officinalis is used in wound and ulcer treatments as well as to heal raw abrasions of the skin as a lotion or compress, due to the presence of tannin which acts as an astringent and anti-inflammatory agent (Fluck H., 1988; Grieve M., 1984).

Another study found that the *Salvia* species oils were used as an antiseptic, the tannin as a local anti-inflammatory agent. The bitter taste induced a pleasant sensory feeling in the mouth and throat which was used as a mouthwash or gargle. *Salvia* species are also used as calming agents as herbal tea all around the world, due to spasmolytic, carminative, diuretic, hemostatic and activities (Altun et al., 2007).

It can be used in skin care, such as for treatment of large pores as a compress or infusion, as a face pack, and as a cream for cold sores near the mouth (Back P., 1987). Crushed fresh leaves of *S. officinalis* have been used to get rid of warts on the face, hands, arms, neck and throat. A herbal wash of the same fresh leaves has been used to relieve bumps, wounds, cuts, sores and other skin injuries (Boyd Eddie L., 1984).

S. officinalis fresh leaves are used as an infusion for darkening, toning hair and in cases of alopecia, it can be rubbed on to the scalp every other day to ensure healthy shining hair. It is good for dark hair, strengthening the hair and deepening the natural colour (Genders Roy, 1985; Back P., 1987). A mixture of *S. officinalis* and rosemary has been used to maintain the sheen of dark, curly hair and stimulate hair growth (Lewis W.H. et al., 1977). de Bairacli Levy described a recipe for hair tonics and lotions by cutting up a handful of *S. officinalis* leaves and tops and the same amount of rosemary (de Bairacli Levy, 1991).

In the study of Onlooker results indicated that *S. officinalis* could be useful in the fight against Alzheimer's disease. The oil obtained from this plant inhibits the acetylcholinesterase activity, which plays a role in memory loss (Onlooker, 1995).

In the study of Eidi et al. results showed the effect of *S. officinalis* essential oils in diabetic rats, it had given a significant decrease in serum glucose (Eidi et al., 2005). Also, results showed that aqueous extracts of *S. officinalis* leaves had inhibitiory effects on pro-oxidant-induced lipid peroxidation in the rats brain and liver homogenates (Oboh and Henle, 2009).

Salvia species have multiple pharmacological effects including antibacterial, anti-oxidative, anti-inflammatory, antiviral, anti-malarial, anti-diabetic, antitumor and anticancer properties. Also, some studies found that a part of these activities depended on essential oil composition (Alizadeh and Shaabani, 2012).

The antimicrobial properties of *Salvia* species essential oils have been well known for many years, as naturally occurring antimicrobials, which have been applied to pharmaceutical botany, pharmacology, medical and clinical microbiology, phytopathology and food preservation. Recently, essential oils of the *Salvia* species have been investigated. It was found that the strong antimicrobial activity was based on the presence of more than 100 active compounds which can be classified into monoterpene hydrocarbons, oxygenated monoterpenes, sesquiterpene hydrocarbons, non-isoprenoid compounds and oxygenated sesquiterpenes (Fu Z. et al., 2013).

In the investigation of Privitera G. et al. results showed the effect of *S. officinalis* essential oils and its three main components in human lung cancer A549 and NCI-H226 cells. These cells were treated with various concentrations of *S. officinalis* essential oil and with a combination of two and three of its main constituents (1,8-cineole, α- thujone and camphor), at a dose of 100 and 200 μg/ml for 48 and 72 hours. The anti-proliferative activity was evaluated by the MTT assay. The results showed that the treatment with *S. officinalis* essential oils, at a dose of 200 μg/ml for 72 hours, caused significant growth inhibition on both cell lines, compared to respective controls (Figure 5). The same result was obtained from the treatment with the combination of α-thujone and 1,8-cineole, α-thujone and camphor and 1,8-cineole and camphor, at a dose of 200 μg/ml each for 72 hours (Figure 6), and with the association of α-thujone, 1,8-cineole and camphor at a dose of 100 μg/ml each for 48 hours (Figure 7) (Privitera G. et al., 2014).

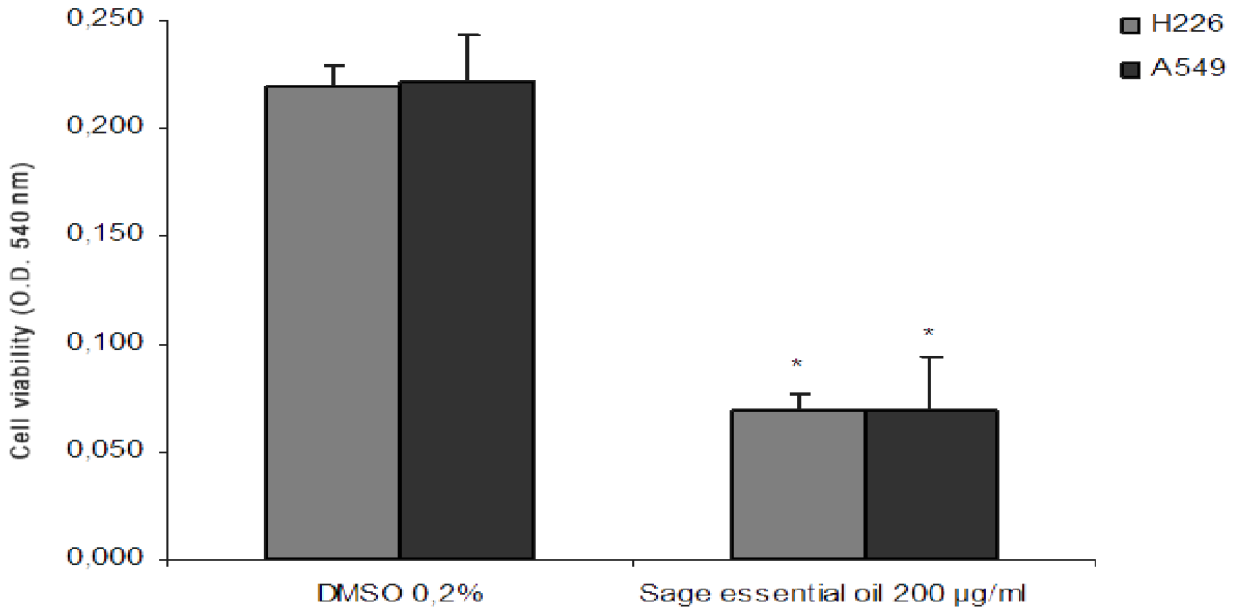


Figure 5: The effect of essential oil of the *S. officinalis* aerial parts on A549 and H226 cell viability after 72 h of treatment.The results were expressed as a percentage of MTT reduction by control cells maintained in dimethylsulfoxide (DMSO). Each value represents the mean ± SE from 6 experiments, performed in esaplicate (*** P<0.01, compared to control) (Privitera G. et al., 2014).

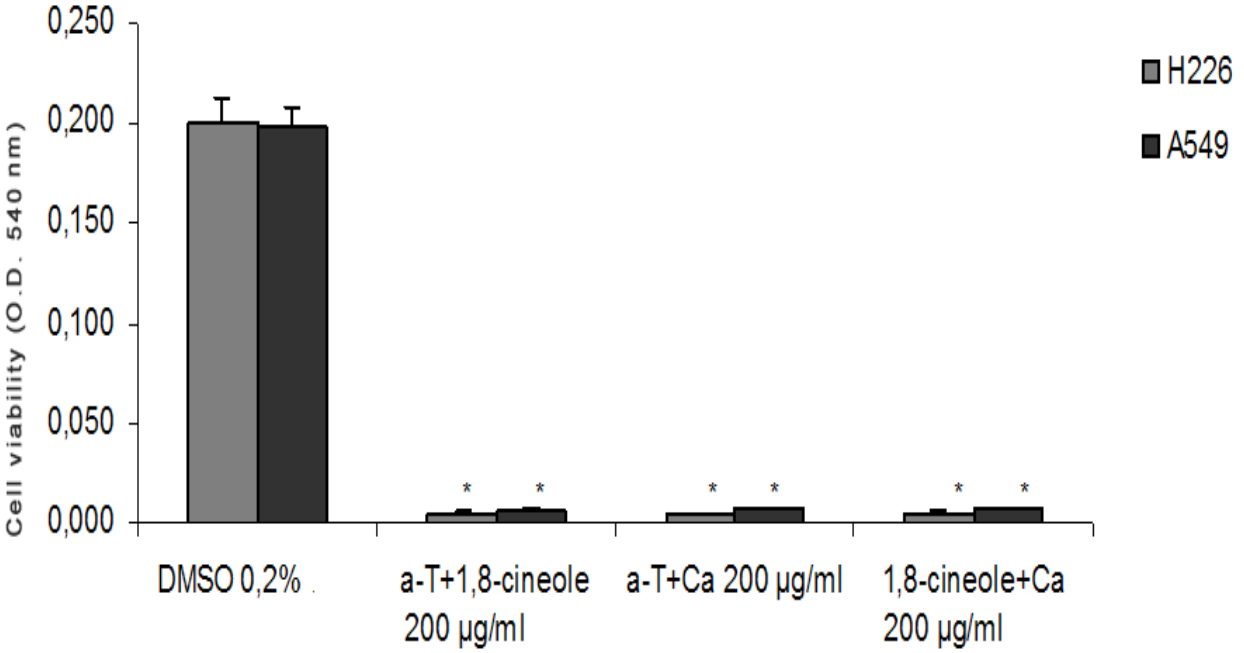


Figure 6: The effect of treatment with couples of three main components of sage essential oil on A549 and H226 cell viability after 72 h of treatment. The results were expressed as a percentage of MTT reduction by control cells maintained in dimethylsulfoxide (DMSO). Each value represents the mean ± SE from experiments, performed in esaplicate (*** P<0.01, compared to control) (Privitera G. et al., 2014).

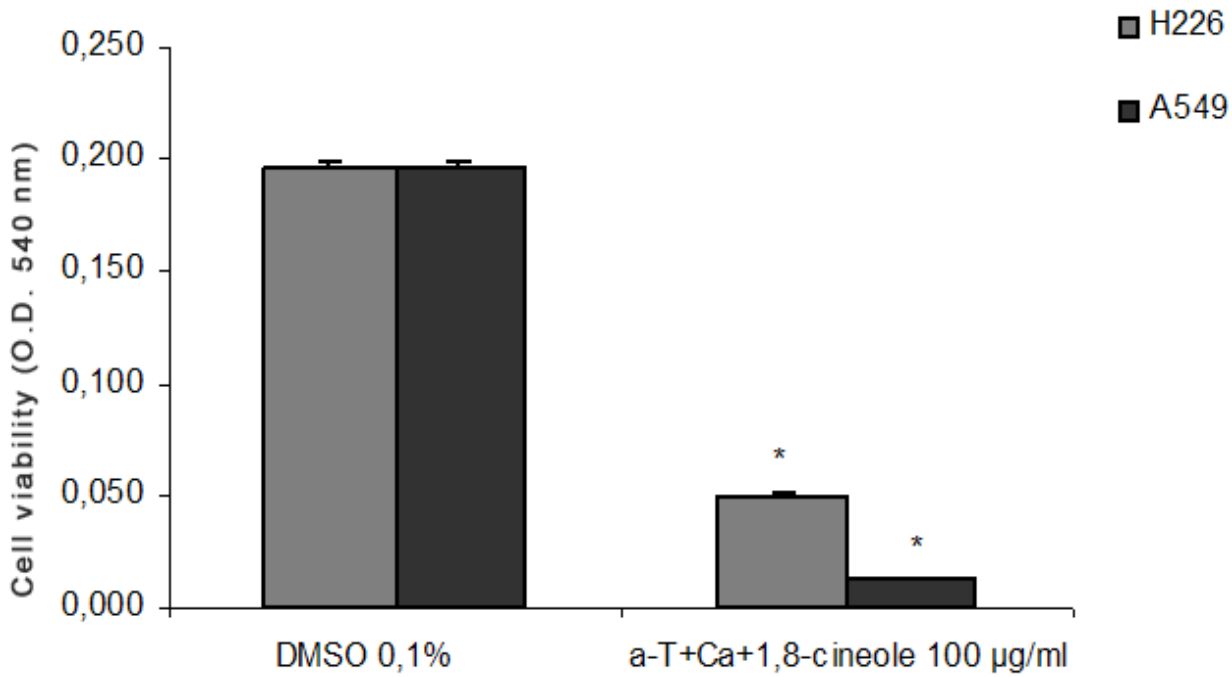


Figure 7: The effect of α-thujone, 1,8-cineole and camphor, at a dose of 100 µg/ml each, on A549 and H226 cell viability after 48 h of treatment. The results were expressed as a percentage of MTT reduction by control cells maintained in dimethylsulfoxide (DMSO). Each value represents the mean ± SE from 6 experiments, performed in esaplicate (*** P<0.01, compared to control) (Privitera G. et al., 2014).

3.3. *Salvia aegyptiaca* L.

Figure 8: *Salvia aegyptiaca* L

(Adapted from: www.florasilvestre.es, December 2015)

3.3.1. Taxonomy

Kingdom:	Plantae
Order:	Lamiales
Family:	Lamiaceae
Subfamily:	Nepetoideae
Genus:	Salvia
Species:	aegyptiaca

3.3.2. Occurrance and morphology

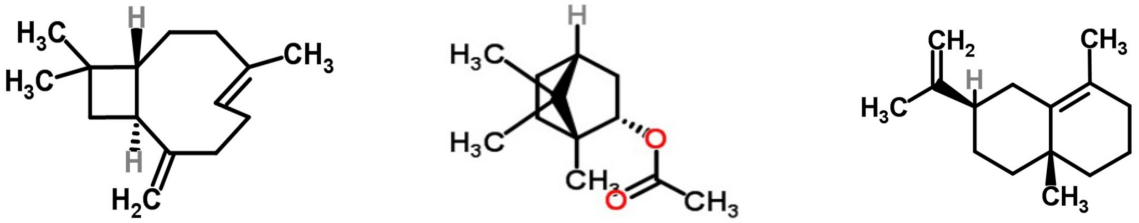
Saliva aegyptiaca L. (Egyptian sage) is a green dwarf shrub that grows in various locations in the Arabian Peninsula, Egypt, Palestine, Iran and Afghanistan (Rizk and El-Ghazaly, 1995; Al-Yousuf et al., 2002). It grows on gypsum soils or dry rocky sunny and well drained piedmont, hamadas, regs and deserted rangelands (Pottier-Alapetite G., 1981). Arabic Names: Ghashba, Ghashbama, Raala, Shajrat al Ghazal Green dwarf shrub (Migahid A.M., 1989).

S. aegyptiaca L. is a canescen herb of up to 20 cm in hight with very intricate branches with stiff and almost spinescent branches having retrorse eglandular hairs. Leaves are opposite, few, narrow linear-elliptic to oblong-linear, sessile or almost sessile base and toothed. Flowers are 2-4 whorls, small, numerous and a pale violet corolla. Corolla is 25 glabrous about one and a half times as long

as calyx. Calyx is 2-lipped, puberulent or hispid of long white hairs (Migahid A.M., 1989; Pottier-Alapetite G., 1981; Siddiqi M.A., 1984).

3.3.3. Chemical composition

Mohammadi S. et al. analyzed the composition of *S. aegyptiaca* L essential oil by GC and CG-MS. The plant was collected in Algeria. Thirty five components were found (Table 8). The main components were limonene (3.2%), bornyl acetate (8.5%), β-bourbonene (2.9%), β-caryophyllene (10.2%), β-gurjunene (7.6%), selina-4,11-diene (9.7%), germacrene D (7.0%), bicyclogermacrene (2.3%), δ-cadinene (3.4%), germacrene B (4.8%), spatulenol (3.1%), β-caryophyllene oxide (6.2%) and α-cadinol (2.9%). The identified components represented 91.1% of the oil. Monoterpenic hydrocarbons were present at moderate proportion (15.8%) while the sesquitepernic fraction represented the major fraction (71.9%). The oxygenated fraction represented 28.3% of the total oil composition. The main components were as shown in Figure 9 (Mohammadi S.et al., 2014).



beta caryophyllene bornyl acetate selina-4,11-diene

Figure 9: Principal constituents of *Salvia aegyptiaca* L essential oil (Graphics created with Chemspider).

Table 8: Volatile oil composition of *Salvia aegyptiaca* L. (Mohammadi S.et al., 2014).

Compounds	RI	RT	%
β-pinene	979	11703	0.4
myrcene	989	12104	0.5
para cymene	1025	13.316	0.5
limonene	1030	13.470	3.2
1,8-cineol	1034	13.587	0.4
(Z)- β-ocimene	1037	13.685	1.8
nonanal	1105	15.931	0.7
borneol	1175	18.050	0.5
decanal	1207	18.995	0.4
bornyl acetate	1286	21.233	8.5
β-copaene	1378	23.687	1.1
β-bourbonene	1387	23.908	2.9
β-caryophyllene	1423	24.835	10.2
β-gurjunene	1435	25.109	7.6
(*E*)- β-farnesene	1452	25.551	1.9
α-humulene	1460	25.731	1.1
alloaromadendrene	1464	25.835	1.5
selina-4,11-diene	1476	26.134	9.7
germacrene D	1484	26.345	7.0
valencene	1495	26.614	0.4
bicyclogermacrene	1498	26.691	2.3
germacrene A	1511	26.990	0.5
γ-cadinene	1516	27.095	1.3
δ-cadinene	1520	27.194	3.4
α-cadinene	1539	27.649	0.6
germacrene B	1563	28.202	4.8
spathulenol	1580	28.605	3.1
oxydecaryophyllene	1587	28.756	6.2
1,10-di-*epi*-cubenol	1619	29.482	0.9
caryophylla-4(14),8(15)-diene-ol	1638	29.908	0.4
epi α-cadinol	1645	30.067	1.2
epi α-muurolol	1647	30.102	0.9
α-cadinol	1659	30.368	2.9

heptadecane	1699	31.264	0.3
6,10,14-trimethyl-pentadecan-2-one	1840	34.206	2.0

3.3.4. Effect and application

Lamiaceae is one of the most important medicinal plant families worldwide. It's considered as a significant resource for potential phytochemical compounds, which could be used to cure sever diseases related to kidney, stomach and thyroids problems (Handa S.et al., 2006).

The *Salvia* species have been widely commonly used as folk medicine, such as for spasmolytic, antiviral, antibacterial, antioxidant, antitumor and anti-inflammatory treatments and have further been used in the treatment of nervous, mental, and gastrointestinal conditions (Lu Y. et al., 2002; Tepe B. et al., 2004).

S. aegyptiaca seeds have been used in local folk medicine as a demulcent aganist diarrhea and piles, and the whole plant is used for gonorrhea, diarrhea and haemorrhoids, eye diseases and as an antiseptic, antispasmodic and stomachic remedy (Rizk and El-Ghazaly, 1995). *S. aegyptiaca* is also used in cases of nervous disorders, dizziness, trembling and stopping perspiration (Al-Yousuf et al., 2002; Gorai et al., 2011).

S. aegyptiaca essential oil administration showed significant decreases of urea without significant change in kidney and liver parameters after seven days of *S. aegyptiaca* treatment. These results indicated protective activity of *S. aegyptiaca* against liver and kidney damage. Although extensive phytochemical work on *S. aegyptiaca* has been done there are only a few reports on the pharmacological properties of the plant, and no toxicological studies (Al-Yousuf et al., 2002).

Recently, in the study of Tohamy A. et al. *S. aegyptiaca* extracts were examined *in vitro* in normal male adult mice, in order to evaluate the beneficial effects of potential tannins, total flavonoids and total phenolics. The results indicated that *S. aegyptiaca* extract administration supported liver function through a significant reduction in alkaline phosphatase and total bilirubin and supported kidney function through decrease of urea as well as had antioxidant properties (Tohamy A. et al., 2012).

3.4. *Moringa peregrina*

Figure 10: *Moringa peregrina*

(Adapted from: www.prota4u.org, December 2015)

3.4.1. Taxonomy

Kingdom:	Plantae	
Subkingdom:	Tracheobionta	
Super division:	Spermatophyta	
Division:	Magnoliophyta	
Class:	Eudicots	
Subclass:	Rosids	
Order:	Brassicales	
Family:	Moringaceae	
Genus:	Moringa	
Species:	Peregrina	(Olson M.E., 1999)

3.4.2. Occurrence and morphology

The family Moringaceae contains 33 species of the same genera, four of which are accepted (*M. oleifera, M. ovalifolia, M. peregrine* and *M. stenopetala*) four are synonym (*M. moringa, M. ovalifoliolata, M. pterygosperma* and *M. zeylanica*) and twenty five are unassessed (Mabberley D.I., 1987), thirteen species, occur in “old world” countries (Table 9) (Mark E.O.et al., 2000).

Table 9: Geographic distribution of thirteen documented *Moringa* species and their morphotypes (Mark E.O.et al., 2000).

Species	Geographical location
Bottle trees:	
M. drouhardii Jum	Madagascar
M. hildebrandtii Engl.	Madagascar
M. ovalifolia Dinter & A. Berger	Namibia and S.W. Angola
M. stenopetala (Baker f.) Cufod	Kenya and Ethiopia
Slender trees:	
M. concanensis Nimmo.	India
M. oleifera Lam.	India
M. peregrina (Forssk) Fiori	Red Sea, Arabia, Horn of Africa
Tuberous shrubs and herbs of North Eastern Africa:	
M. arborea Verdc.	North Eastern Kenya
M. borziana Mattei	Kenya and Somalia
M. longituba Engl.	Kenya, Ethiopia, Somalia
M. pygmaea Verdc.	North Somalia
M. rivae Chiov.	Kenya and Ethiopia
M. ruspoliana Engl	Kenya, Ethiopia, Somalia

M. peregrina grows in a wide geographic range, from the Dead Sea area discontinuously on the Red Sea coast to the north of Somalia and around the Arabian Peninsula to the mouth of the Arabian Gulf and the mountains of Sinai in Egypt (Tackholm, 1974; Boulos, 1999). The *Moringa* tree is very resistant aganist dry soil and can grow with groundwater within several meters deepness. This resistance might be due to xerophytic characteristics of the tree, which appear when soil moisture deceases (Al-Gohary and Hajar, 1996).

M. peregrin is a rare species because of the severe drought and the excessive extraction of fatty oil from seeds, as well as tree cutting which is used as firewood and fodder (Hegazy et al., 2008).

It is an extremely fast growing perennial tree or shrub that can reach about 3 to 10 m in height in just 10 months after the seed was planted (Abd El-Wahab, 1995). It grows naturally on altitudes up to 1,000 m above sea level. It can also grow well on hillsides with 5-15 m height. The diameter of the tree is 20-40 cm with a grayish-green bark, it has long alternate leaves (20-70 cm) with a full complement of tiny leaflets which drop when the leaf matures. The flowers (10-15 mm long) are bisexual, yellowish white to pink, showy, fragrant and scented (Tackholm, 1974; Boulos, 1999; Gomaa and Pico, 2011). The flowering season is in spring from March to April and fruiting periods last up to three months. The fruit has an elongated capsule (10-25 x 1-1.5 cm). Seeds are globose to ovoid or trigonous (10–12 × 10–12 mm), brown and hard-coated (Hegazy et al., 2008; Collenette, 1985; Olson, 2001).

3.4.3. Chemical composition

In the study of Abd El-Baky and El-Baroty who examined the fatty acids composition of the isolated oil from *M. peregrina* seeds, the major compositions were oleic (65.36%), linoleic (15.32%) and palmitic (12.44%) acids (Abd El-Baky and El-Baroty, 2012).

Osman and Abohassan detected the composition of amino acids found in the seeds and leaves of *M. peregrina* (Table 10) and the mineral content (mg/100 g) of *M. peregrina* leaves (Table 11) (Osman and Abohassan, 2012).

Table 10: Composition of amino acid (%) in seed and leaf of *M. Peregrina* (Osman and Abohassan, 2012).

Amino acid	Seed	Leaf and stem
aspartic	4.4	4.2
threonine	5.71	1.63
serine	4.05	1.51
glutame	18.14	4.06
proline	3.71	3.02
glycine	3.62	1.87
alanine	2.05	2.62
cystine	0.34	1.87
valine	2.98	2.95
methionine	1.36	0.36

isoleucine	2.84	4.66
leucine	5.44	4.74
tryosine	1.61	1.63
phenyalanine	3.33	2.75
histidine	3.61	1.55
lysine	2.75	2.91
arginine	10.78	2.67

Table 11: Mineral content (mg/100 g) of *M. peregrina* leaves (Osman and Abohassan, 2012).

Mineral content	(mg/100 g)
Ca	23.9
Fe	84.46
Mg	5.3
P	1.9
K	35
Na	10.9
Zn	2.208
Cu	0.786
Mn	17.79

Suleiman A.et al. investigated the composition of essential oil from the seed kernel and leaf of *M. Peregrina.* The main components were isobutyl isothiocyanate and isopropyl isothiocyanate (Table 12) (Suleiman A.et al., 2009).

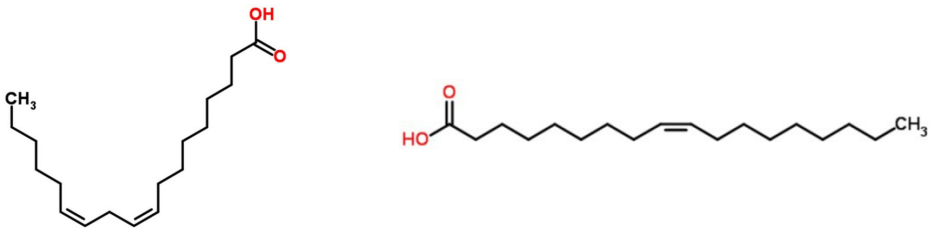
Table 12: Volatile constituents of the seed kernel and leaf of *M. Peregrina* (Suleiman A.et al., 2009).

Components Retention	%in seed kernel	%in leef
isopropyl isothiocyanate	4.9	10.2
sec-Butyl isothiocyanate	0.5	<0.1
isobutyl isothiocyanate	94.0	88.5
n-Butyl isothiocyanate	0.5	0.4

M. peregrina seed oil has shown many sterol componants (Table 13) such as β-sitosterol, campesterol, stigmasterol and Δ-5-avenasterol (Tsaknis et al., 1999; Lalas and Tsaknis, 2002).

Table 13: The major sterols composition of *M. peregrina* seed oil (Tsaknis et al., 1999; Lalas and Tsaknis, 2002).

Sterols	Per cent of total sterols
campesterol	23.69
stigmasterol	24.54
β-sitosterol	28.30
Δ-5-avenasterol	16.10
Total sterol (mg/kg)	2156



linoleic acid oleic acid

Figure 11: The structures of the ingredients of *M. peregrina* (Graphics created with Chemspider).

Abdel-Rahman T. et al. investigated the phytochemical and pharmacological properties of *M. Peregrina* and determined the presence of six constituents from the aerial parts: lupeol acetate, α-amyrin, β-amyrin, sitosterol, sitosterol-3-O-D-glucoside and apigenin which displayed antibacterial activity (Abdel-Rahman T. et al., 2010).

3.4.4. Effect and application

Moringa peregrina could become one of the most valuable plants which is grown in arid lands, not only for humans but also for animals. It has different medicinal and economic significance due to its unique constitution of oil, carbohydrates, proteins fiber and ash contents (Somali et al., 1984 a; Al kahtani, 1995).

M. peregrina seeds and leaves have valuable nutrients for humans because they contain a high proportion of oils. Egyptian seeds contain 42.23% oil (Abd El Baky and El-Baroty 2012).

The study of Tsaknis showed that the seed oil had higher tocopherols which consisted of α-tocopherol 145 mg/kg , β-tocopherol and 58mg/kg and δ-tocopherol 66 mg/kg. This high content of tocopherols acts as a protector for the oil during the storage and processing (Tsaknis, 1998). Results showed that *M. peregrina* seed oil was resistant up to 10.5 hours at 120 °C, which is higher than extra virgin olive oil (8.9 hours). Due to these characteristics of *M. peregrina* seed oil, it can be useful for industrial applications and edible purposes (Lalas et al., 2012).

Moringa in water treatment

Water is vital to life, but its quality has deteriorated due to wrong human activities causing about 80% of human diseases especially in many developing countries. Many disinfectants and chemicals which are used in water purification may cause serious health hazards if used incorrectly in the course of the treatment process. Results indicated that continuous use of aluminium sulphate as a coagulant in water treatment leads to a increased level of aluminium in the brain which may be a risk factor for Alzheimer's disease (Miller R.G. et al., 1984; Mallevialle J.et al., 1984; Letterman R. et al., 1988). For these reasons, scientists search for safer organic alternatives. *M. peregrina* seeds are commonly used to decrease water turbidity and to increase water purification in many rural areas to avoid the health risks of drinking water. Turbidity of water had a significant effect on the microbiological quality and can interfere with the detection of viruses and bacteria. Systematic research has shown that *M. peregrina* seeds act as an effective water clarifying agent across a wide range of various colloidal suspensions with low cost, point of use, low risk drinking water treatment protocol (Marobhe NJM., 2008).

The leaves and pods are considered an excellent source of vitamins, proteins, mineral and several amino acids including sulfur-containing amino acids methionine and cystine, with very low levels of fat and carbohydrates, which can be used in short supply with the Bedouin diet (Makkar and Becker, 1996).

M. peregrina species leaves have various biological activities. They are used for their antitumor, antioxidant, anti-inflammatory, diuretic, anti-hepatotoxic properties as well as hypotensive, hypoglycemic and hypercholesterolemia actions (Sreelatha S., and Padma P. R., 2009).

In the study of Fuglie L.J. traditional therapeutic & prophylactic uses according to plant part were explained (Fuglie L.J., 1999):

Leaves: bacterial infection, helminth parasite, bronchitis, fever, prostate cancer, anemia, colitis, diarrhea, dysentery, lactation enhancer, skin antiseptic, scurvy.

Flowers: bacterial infection, common cold, helminth parasite, throat infection, tonic, hysteria, headache.

Seeds: warts, fever, arthritis, bladder disorder, scurvy.

Pods (drumsticks): helminth parasite, joint pain.

Roots: dental caries, toothache, common cold, fever, asthma, cardio tonic, diarrhea, flatulance, edema, epilepsy, hysteria, headache, astringent, skin rubefacient, gout, hepatomegaly, kidney pain, splenomegaly, scurvy.

Bark: dental caries, toothache, common cold, snakebite, scorpion bite, colitis, digestive, epilepsy, hysteria, headache, scurvy.

Gum: dentalcaries, toothache, syphalis, typhoid, earache, fever, asthma, dysentery, headache.

Oil (from seeds): purgative, hysteria, prostate function, bladder disorder, gout, scurvy.

Mekonnen Y. et al. found that the infusion of the leaves and roots in water was used to treat stomach disorders, hypertension, malaria, diabetes and asthma (Mekonnen Y. et al., 1999).

Until now, there are not many pharmacological investigations conducted on *M. peregrina* components. The most important of them are the only sources of information:

In the study of Akbar and Yahya results found that *M. peregrina* aerial part extracts contained flavanoid, tannins, sterols, triterpenes and saponins. These extracts showed activities against *Stapylococcus aureus* and *Bacillus subtilis* with minimal inhibitory concentrations (MIC) of 2 mg/ml each and stimulating the central nervous system activities (Akbar and Yahya, 2011).

In another study Lalas et al. investigated the antimicrobial activity of *M. peregrina* and the results showed that the essential oil was active against: *Staphylococcus aureus*, *Staphylococcus epidermidis*, *Pseudomonas aeruginosa*, *Enterobacter cloacae*, *Klebsiella pneumoniae*, *E. coli*, *Candida albicans*, *C. tropicalis* and *C. glabrata*. The MIC for these respective microbes are 3.5, 3.35, 4.38, 4.8, 4.3, 4.95, 5.7, 3.3 and 3.25 mg/ml, respectively. The results have shown that the essential seed oil of *M. peregrina* has a strong effect (Lalas et al., 2012).

M. peregrina essential seed oil showed higher anti-oxidant activity comparable to that of known anti-oxidants, such as butylated hydroxyanisole (BHA), tocopherol and butylated hydroxytoluene (BHT). Results showed antiproliferation activities by inhibiting the growth of three cancer cell lines, hepatocellular carcinoma (HepG2), breast adenocarcinoma cells (MCF-7) and colon carcinoma (HCT-116). The results indicated a good antiproliferation effect on examined human cancer cells MCF-7, which was the most sensitive cell line followed by HeP-G2 and HCT-116 and paclitaxel as an anti-cancer drug, shown in Figure 12 and Table 14 (El Baky and El-Baroty, 2012).

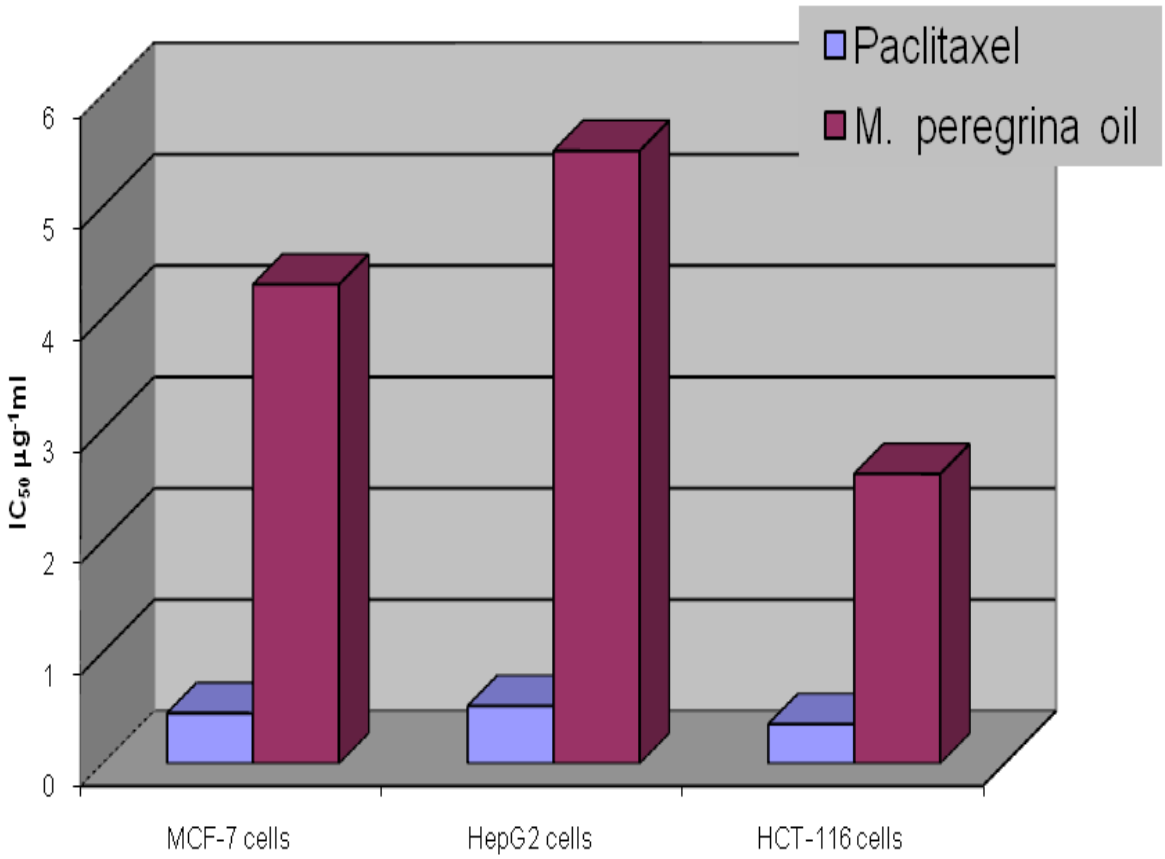


Figure 12: The growth inhibition effect (IC50 µγ/ml) of *M. peregrina* oil on three human cancer cell models (El Baky and El-Baroty, 2012).

Table 14: Anti-proliferative effect of *M. peregrina* oil against three models of human cancer cell lines MCF-7 breast, HepG2, HCT116 and Paclitaxel as an anti-cancer drug (El Baky and El-Baroty, 2012).

Human cancer cell lines	IC50 μg/ml	
	M. peregrina oil	Paclitaxel
MCF-7	2.92	0.45
HepG2)	9.40	0.52
HCT-116	9.48	0.35

It is known worldwide, that some essential oils exhibit antibacterial activity and may be an alternative to antibiotics. New opportunities are given to prevent antibiotic resistance.

Recently, in the study of Hajar and Gumgum Jee authors showed that the ethanolic extract of *M. peregrina* leaves, seed coat and seed endosperm had antibacterial and antifungal properties. Leaves extract showed activity against *S. aurueus, M. lutues, B. subtilis, K. peneumonia, P. Aeruginosa* and *E. coli* with a magnitude of inhibition zones of 27.67, 23.67, 20.00, 26.67, 20.67 and 19.67mm, respectively, but the extract of seed endosperm was only active against *M. lutues, E. coli, and K. peneumonia* with inhibition zones of 13.33, 17.67 and 16.33 mm, respectively. Results indicated that all extracts had higher inhibitory activities compared to the standard antibiotics such as streptomycin and ciprofloxacin (Hajar and Gumgumjee, 2014).

Extracted leaves explored the antimicrobial activity aganist *S. aurueus and C. albicans* at the molecular level by using random amplification of polymorphic DNA (RAPD). The results indicated a molecular change induced by leaves extracts, which demonstrated a polymorphic band pattern for most treated microbes compared to the untreated strains (Hajar and Gumgumjee, 2014).

Several compounds isolated from various parts of M. peregrina and their medical importance summarized according to plant part:

Aerial part

6,8,3,5-Tetramethoxy apigenin: anti-inflammatory, analgesic activities and inhibiting the development of gastric lesion in rats (Elba Tran et al., 2005).

6-Methoxy-acacetin-8-C-β-glucoside: cytotoxic activities against breast (MCF 7) and colon (HCT 116) cancer cell lines; antihyperglycemic effect (El-Alfy et al., 2011).

Apigenin: antibacterial, cytotoxic activities against breast (MCF 7) and colon (HCT 116) cancer cell lines; anti hyperglycemic effect (Abdel-Rahman T.et al., 2010; El-Alfy et al., 2011).

Chrysoeriol-7-0- rhamnoside: anti-inflammatory, analgesic activities; inhibited the development of gastric lesion in rats; cytotoxic activities against breast (MCF7) and colon (HCT 116) cancer cell lines; antihyperglycemic effect (Elbatran et al., 2005; El-Alfy et al., 2011).

Lupeol acetate: Antibacterial, cytotoxic activities against breast (MCF 7) and colon (HCT 116) cancer cell lines; antihyperglycemic effect (Abdel-Rahman T.et al., 2010; El-Alfy et al., 2011).

Neochlorogenic acid: cytotoxic activities against breast (MCF 7) and colon (HCT 116) cancer cell lines; antihyperglycemic effect (El-Alfy et al., 2011).

Quercetin: anti-inflammatory, analgesic activities, inhibited the development of gastric lesion in rats; cytotoxic activities against breast (MCF7) and colon (HCT 116) cancer cell lines; antihyperglycemic effect (Elbatran et al., 2005; El-Alfy et al., 2011).

Quercetin-3-o-rutinoside (rutin): anti-inflammatory, analgesic activities; inhibited the development of gastric lesions in rats; cytotoxic activities against breast (MCF7) and colon (HCT 116) cancer cell lines; antihyperglycemic effect; antioxidant (Elbatran et al., 2005; El-Alfy et al., 2011;Dehshahri et al., 2012b).

Rhamnetin: cytotoxic activities against breast (MCF 7) and colon (HCT 116) cancer cell lines; antihyperglycemic effect (El-Alfy et al., 2011).

Rhamnetin-3-o-rutinoside: cytotoxic activities against breast (MCF 7) and colon (HCT 116) cancer cell lines; antihyperglycemic effect (El-Alfy et al., 2011).

Sitosterol: antibacterial, cytotoxic activities against breast (MCF 7) and colon (HCT 116) cancer cell lines, anti hyperglycemic effect (Abdel-Rahman T.et al., 2010; El-Alfy et al., 2011).

Unknown (aerial part extracts): stimulating central nervous system activities and antimicrobial activities (Akbar and Yahya , 2011).

α-Amyrin: antibacterial, cytotoxic activities against breast (MCF 7) and colon (HCT 116) cancer cell lines; anti hyperglycemic effect (Abdel-Rahman T.et al., 2010; El-Alfy et al., 2011).

β-Amyrin: antibacterial, cytotoxic activities against breast (MCF 7) and colon (HCT 116) cancer cell lines; anti hyperglycemic effect (Abdel-Rahman T.et al., 2010; El-Alfyet al., 2011).

Leaves

Quercetin-3-o-rutinoside (rutin): anti-inflammatory, analgesic activities; inhibited the development of gastric lesions in rats; cytotoxic activities against breast (MCF7) and colon (HCT 116) cancer cell lines; antihyperglycemic effect; antioxidant (Elbatran et al., 2005; El-Alfy et al., 2011; Dehshahri et al., 2012).

Total phenols: antioxidant (Dehshahri et al., 2012b).

Seeds

Unknown (seed extracts): anti-inflammatory and antioxidant agent (Koheil et al., 2011).

Unknown (seed essential oil): antibacterial; inhibiting the growth of breast adenocarcinoma cells (MCF-7), hepatocellular carcinoma (HepG2) and colon carcinoma (HCT-116); anti-oxidant activity (Lalas et al., 2012; Abd El Baky and El-Baroty, 2012).

Seed coat, seed kernel and stem

Isothiocyanates: antioxidative, antibacterial, anticancer and chemoprotective properties (Afsharypuor et al., 2010; Dehshahri et al., 2012a).

3.5. *Artemisia judaica* L.

Figure 13: *Artemisia judaica* L.

(Adapted from: www.sahara-nature.com, December 2015)

3.5.1. Taxonomy

Kingdom: Plantae

family: Asteraceae

Genus: Artemisia

Species: judaica

3.5.2. Occurance and morphology

The genus Artemisia, known as worm wood, is a member of the big family of Asteraceae and consists of more than 800 species. It is widespread around the world and provides a source of medically valuable essential oils and secondary metabolites (Tan R.X. et al., 1998; Vijayalakshmi A. et al., 2011). Many species of the genus *Artemisia* are known as aromatic plants and have a characteristic scent or taste, caused by monoterpenes and sesquiterpenes (Paris and Moise, 1971).

In Egypt, Artemisia is represented by four wild species: *A. Judaica* L., *A. monosperma, A. scoparia and A. verlotiorum* (Boulos L., 2002).

Artemisia judaica is one of the common species of the genus Artemisia that grows widely in the deserts and on the Sinai Peninsula in Egypt and North African and Middle-Eastern countries where it is known by the Arabic name of "shih" (Tackholm V., 1974). It is widely used in folk medicine and is recommended as a healing plant in traditional medicine by Bedouins there. It is used as tea by the Saudi Arabian population and in Egypt Sinai (Tackholm V., 1974; Nofal S.M.et al., 2009).
A. judaica is a perennial fragrant herb of 50-80 cm, strongly aromatic, with woody bases and strong spreading branches, densely tomentose, grayish to whitish, covered by woolly hairs. Leaves are grayish, dissected, crowded, short, petiolate, round in outline, heads are rounded 3-4 mm indiameter, crowded and made of tubular florets. Its habitat are sandy soils and wadi beds in deserts. Flowering time is March-April (Zohary M., 1978; Al-Esawi, 1998).

3.5.3. Chemical composition

Two main chemotypes were found in *A. judaica*, the first type was characterized by the presence of artemisyl skeleton-type compounds in the essential oil and the second type was characterized by the absence of these compounds and the presence of relatively high percentages of piperitone and camphor (Ravid U. et al., 1991).

Essential oil of *A. judaica* which grows in the desert of Egypt has a mixture of esters, ketones and aldehydes. The main component was piperitone (Saleh M.A., 1985).

A. judaica essential oil composition of samples collected from the Sinai Peninsula were piperitone (27–46%), *cis*-ethyl cinnamate (5–6%), *trans* ethyl cinnamate (8–13%), camphor (16–23%), chrysanthenone (5–6%) and ethyl-3-phenyl propionate (0.2–0.5%) (Carmali et al., 1991; Putievsky et al., 1992).

In the study of El-Massry F. et al. the chemical composition of *A. judaica* was examined, volatile oils were isolated via hydrodistillation from the leaves and analysed by GC–MS. The plant was collected from the north coast of Egypt. The constituent percentage of the volatile oil is shown in (Table 15). Twenty five components were found accounting for about 99%. The main components were piperitone (45.0%), *trans*-ethyl cinnamate (20.8%) and ethyl-3-phenyl propionate (11.0%) were the predominant components, followed by spathulenol (6.27%), *cis*-ethyl cinnamate (5.64%), 2,6-dimethyl phenole (1.39%) and methyl cinnamate (1.06%) (El-Massry k.F. et al, 2002).

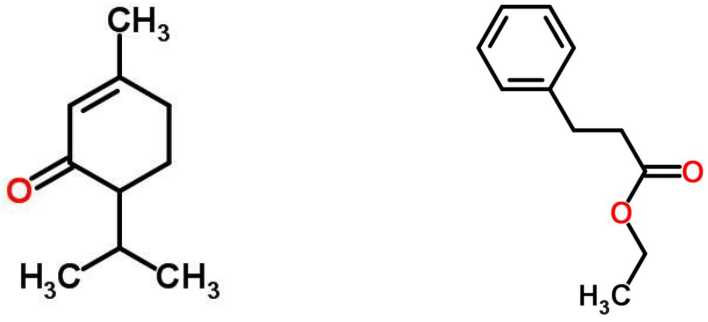
Table 15: Chemical constitution of the volatile oil of *Artemisia judaica* L. (El-Massry k.F. et al, 2002).

No.	Compound	Rt^a (min)	KI^b	Conc.
1	tricyclene	4.12	930.3	0.36
2	α-pinene	5.5	943.5	0.85
3	verbenene	7.12	972.2	0.12
4	sabinene	7.56	979.5	0.88
5	mesitylene	9.41	996.4	0.38
6	p-cymene	10.23	1026	0.84
7	*cis*-thujone	12.55	1110.3	0.18
8	camphor	13.28	1150.2	0.38
9	2,6-dimethyl phenol	14.29	1155.1	1.39
10	chrysanthenol	14.50	1163	0.14
11	benzyl acetate	15.09	1170	0.05
12	cuminaldehyde	17.23	1243.1	0.50
13	carvenone	18.15	1253	0.46
14	piperitone	19.34	1260.4	45.0
15	2-(4-phenoxyl) ethanol	19.45	1296	1.10
16	*cis*-ethyl cinnamate	20.37	1360.6	5.64
17	α-Bentyl benzylmethanol	20.48	1366.3	1.25
18	methyl cinnamate	21.07	1370.5	1.06
19	ethyl-3-phenyl propionate	22.00	1390.4	11.0
20	*trans*-ethyl cinnamate	23.14	1451.5	20.8
21	spathulenol	23.49	1571.3	6.27
22	guaiol	24.48	1588	0.42
23	*cis*-arteannuic alcohol	25.45	1620	0.50
24	γ-eudesmol	27.56	1642	0.18
25	α-caryophyllene acetate	28.50	1686.2	0.20

a Retention time (min) Conc.%: the percent of concentrations based on peak area integration, b confirmed by comparison with Kovat's index on DB5 column (Adams, 1995).

It was observed that the quality of the investigated oil was somewhat similar to the volatile oil composition of samples which were collected from the Sinai Peninsula. In contrast, *trans*-ethyl cinnamate and ethyl-3-phenyl propionate were found in high concentrations (20.81 and 11% respectively), while camphor and chrysanthenol were detected in low concentrations (0.38 and 0.14% respectively), in the present investigated oil of the north coast type (El-Massry k.F. et al, 2002).

The differences in the volatile oil content of *A. judaica* were found to be due to several factors such as plant age, season, different parts of the plant, and also differences found in the samples which were collected from different places. The volatile oil content changed with the season and the highest level was reached during late summer. The volatile oil content of the leaves was higher than that of the branches and flowers (Karawya M. S.et al., 1979; Ravid U.et al., 1992).



piperitone ethyl-3-phenyl propionate

Figure 14: Chemical structures of the main components of *Artemisia judaica* essential oil (Graphics created with Chemspider).

3.5.4. Effect and application

Many *Artemisia* species are used worldwide in tonics, stomachic and stimulant beverages and as antiseptic oils or tinctures applied for the relief of rheumatic pains (Paris & Moise, 1971). *Artemisia* plant extract showed a significant antioxidant effect (Liu C.Z. et al., 2004).

A. judaica L. is used in folk medicine (Batanouny K.H., 1999) and its essential oil constituants has antioxidant activity (El-Masry et al., 2003). *A. judaica* was considered one of the medicinal plants which has a potential of antioxidant activity and can be used as a traditional anti-diabetic agent (Al-Mustafa A.and Al- Thunibat O., 2008).

A. judaica is commonly used as tea in Saudi Arabia and in Egypt Sinai. In the traditional medicine of the Arabic area, it is used for the treatment of gastrointestinal disorders, cardiovascular health, capillary strength, enhanced eyesight, structure of connective tissue, appearance of skin, and immune systems as well as decreased risk of atherosclerosis, cancer and arthritis (Abdalla S.S.et al., 1987; Khafagy S.M.et al., 1988).

A. judaica essential oil has shown anti-malarial, antibacterial, anti-inflammatory effects (Saban et al., 2005). Results showed that *A. judaica* had growth regulator and anti-tumor activities (El-Massry et al., 2002).

A. judaica essential oil, from the flowering branches had many effects such as analgesic, antiinflammatory, antipyretic and anthelmintic. Due to its anti-microbial activity it is used against *Staphylococcus aureus*, *Candida albicans* and *Rodotorula ruba* (Batanouny K.H. et al., 1999).

The essential oil of *A. judaica* showed pronounced insecticide, lantifeedant and fungicidal properties against *Spodoptera littoralis* Boisduval and four plant pathogenic fungi due to the presence of two major constituents piperitone and *trans*-ethyl cinnamate (Abdelgaleil et al., 2008).

In the study of Nofal S.M. et al. pharmacological activities of *A. judaica* water and alcoholic extracts were investigated. Results showed many pharmaclogical effects such as (Nofal S.M. et al., 2009):

Effect on liver functions:

In prolonged oral administration of the plant extracts taken for two months, the results showed a significant increase in alkaline phosphatase and the transaminases activity in the 2nd month after treatment in all the plant extracts groups, when compared to the control group or their basal values (Nofal S.M. et al., 2009).

Effect on body weight gain and organ weights:

In prolonged oral administration of plant extracts taken for two months, the results showed a significant decrease in body weight gain when compared to control group. The ethanolic extract in a dose of 1 g/kg b.wt. showed the most positive effect on rats that were treated (Figure 15). There was no significant effect found on the relative weights of heart, liver, lung, kidneys and spleen in all groups (Nofal S.M. et al., 2009).

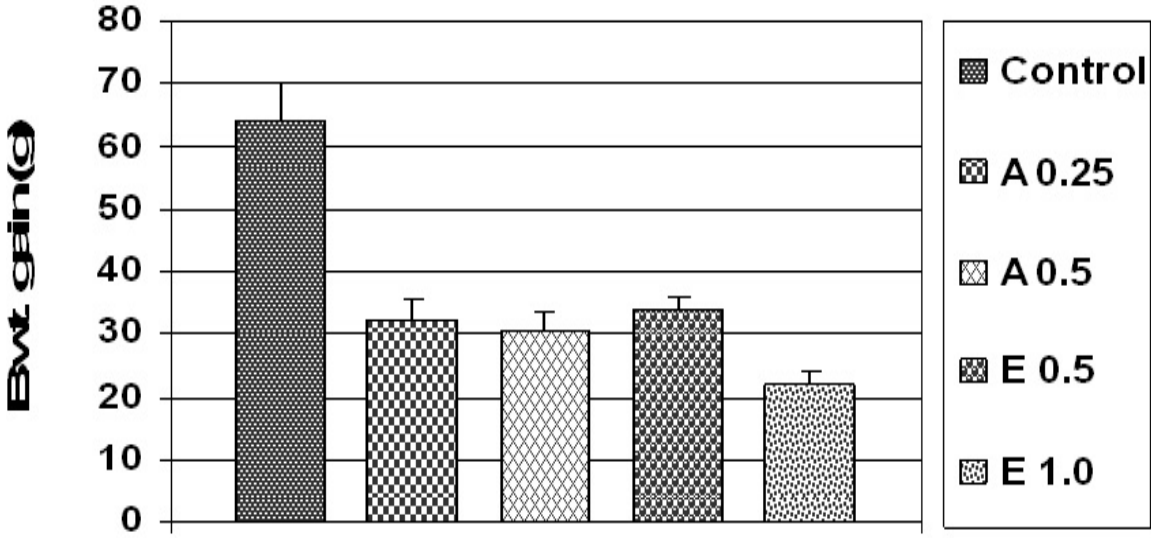


Figure 15: Effect of daily administration of aqueous extract of *A. judaica* for 2 months; on body weight gain in rats in doses of 0.25 (A 0.25) and 0.5 g/kg b.wt. (A 0.5), ethanolic extract in doses of 0.5 (E 0.5) and 1 g/kg b.wt. (E 1.0), (n=10) (Nofal S.M.et al., 2009).

Effect of single dose of *A. judaica* extracts on blood glucose level in diabetic rats:

In oral administration of the tested doses of aqueous and ethanolic extracts as well as glibinclamide (0.01 g/kg b.wt.), results showed a significant decrease in blood glucose levels at 2 and 4 hours after administration, as compared to diabetic non-treated group (Figure 16). In administration of multiple doses of the aqueous and ethanolic extracts, results showed a significant decrease in blood glucose levels as compared to the control diabetic group and found no significant difference from the glibinclamide group (Figure 17) (Nofal S.M. et al., 2009).

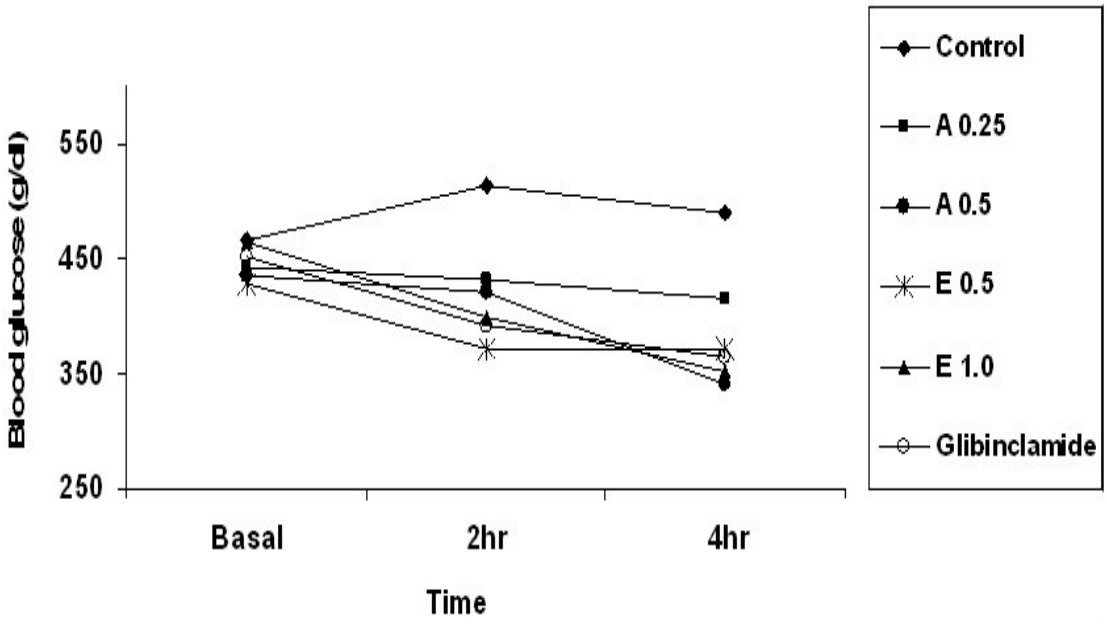


Figure 16: Effect of single administration of aqueous extract of *A. judaica* and glibinclamide on blood glucose level in diabetic rats at doses of 0.25 (A 0.25) and 0.5 g/kg b.wt. (A 0.5), ethanolic extract in doses of 0.5 (E 0.5) and 1g/kg b.wt. (E 1.0), (n=6) (Nofal S.M.et al., 2009).

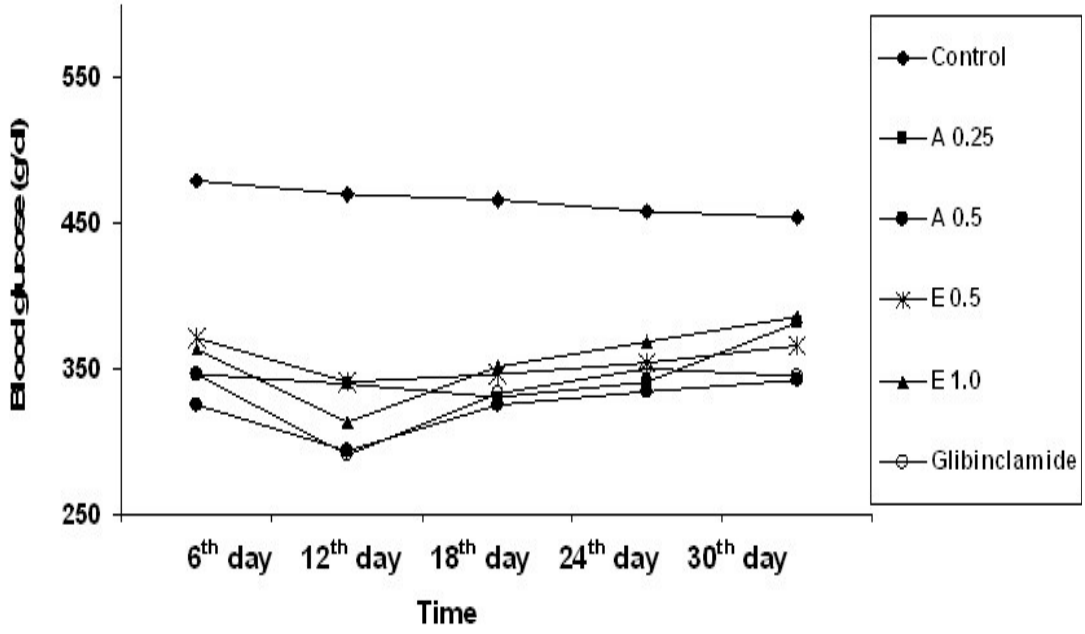


Figure 17: The effect of multiple adminestration of water and ethanolic extracts of *A. judaica* and glibinclamide on blood glucose level in diabetic rats (Nofal S.M.et al., 2009).

4. Conclusion

Egyptian medicinal plants essential oils and their constituents have been used and applied for a long time the treatment a lot of common diseases and indispositions. There are many studies about essential oils of Egyptian plants, which are mostly about complementary and alternative treatment methods to their ability to reduce the risk of many maladies and improve health.

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5.2. List of Tables

5.3. List of Figures

on blood glucose level in diabetic rats at doses of 0.25 (A 0.25) and 0.5 g/kg b.wt. (A 0.5), ethanolic extract in doses of 0.5 (E 0.5) and 1g/kg b.wt. (E 1.0), (n=6) (Nofal S.M.et al., 2009).

Figure 17: The effect of multiple adminestration of water and ethanolic extracts of Artemisia judaica and glibinclamide on blood glucose level in diabetic rats (Nofal S.M.et al., 2009).

6. Curriculum Vitae

Name: Maged Zordoky

Date of birth: 19/8/1981.

Place of birth and nationality: Cairo, Egypt- Egyptian

E-Mail: maged_saber81@yahoo.com