Sudan University of Science and Technology

College of Graduate Studies

A **study of Minerals Content and Chemical Composition of Shih** (***Artemisia herba alba***).

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A Thesis Submitted in Partial Fulfillment of the Requirements of the Master Degree of Science in Chemistry

By

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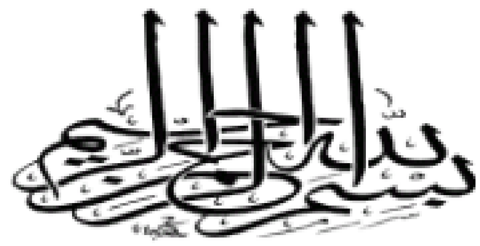
Approval page



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طه (53) .

Dedication

To the soul of my father.

To my mother,

Husband,

Brothers and Sisters.

Acknowledgment

First of all, my endless thanks and praise to, Almighty,Allah, for providing me strength, health and patience to perform this work.

I am deeply grateful to my supervisor Dr. Omer Adam Gibla for, his valuable guidance suggestions and encouragement during the time of this study.

My thanks would be extended to the family of the Industrial Research and Consultancy Center, and the director of Chemical Industry Research Institute, for their support.

Abstract

The aim of this study was to investigate the chemical compositions of the aerial part of Shih (*Artemisia herba alba*) and it's essential oil.

Areial part of Shih sample was purchased from Omdurman Market(Sudan).

The minerals content of the aerial part of Shih was measured by the Inductively coupled plasma (ICP) instrument.

The (ICP) analysis showed a presence of Fe (25 mg/l), S (21 mg\l), P (11mg/l), Al (6.1 mg/l), Mg (0.58mg/l), Ca (0.43mg/l), Mn (0.62mg/l), Na (0.32mg/l), Er (0.55mg/l), Ti (0.25mg/l), Cs (0.56mg/l), as most available minerals in Shih(*Artemisia herba alba*).

Aqueous extract of Shih sample was obtained using soxhlet system.

Steam distillation was used to extract the essential oil from Shih sample. The Oil yield percentage was determined (0.68% ml/100g).

The aerial part aqueous extract and essential oil of Shih sample was analyzed by GC-MS instrument..

GC-MS analysis of the aqueous extract showed a presence of fifteen constituents, dominated by bicycle{10.4.0}hexadecane,14,15diethyl(39.5%), alpha-d-manofuranoside, methyl (20.08%), Ledol (13. 41%),and lilac aldehyde C (5.58%) as the most major constituents.

The GC-MS analysis of Shih essential oil showed a presence of seventy-one constituents, dominated by Camphor (14.37%), Isophorone (13.39%), Cinnamic acid, ethyl ester (10.51%), cinnamaldehyde-(E) (6.11%), 1,3-cyclopentadiene,5,5-dimethyl,1,1 diethyl (5.47%) and Methylene (3.70%), as the most major constituents.

المستخلص

الهدف من هذه الدراسة هو إستقصاء التركيب الكيميائي للجزء العشبي من نبات الشيح (*Artemisia herba alba*) و زيته الأساسي

تم شراء عينة الشيح من سوق أم درمان (السودان). تم قياس المحتوى المعدني للشيح بجهاز بلازما الحث المزدوج (ICP).

أظهر التحليل وجود Fe (25 mg/l), S (21 mg/l), P (11mg/l), Al (6.1 mg/l), Mg (0.58mg/l), Ca (0.43mg/l), Mn (0.62mg/l), Na (0.32mg/l), Er (0.55mg/l), Ti (0.25mg/l), Cs(0.56mg/l). كمعادن أكثر وجودا في الشيح

تم الحصول على المستخلص المائي باستخدام نظام السكوسيليت.

إستخدام التقطير البخاري لإستخلاص الزيت الأساسي للشيح كما تم قياس نسبة الزيت الناتج (0.68% ml/100g).

تم تحليل المستخلص المائي للشيح وزيته الاساسي باستخدام جهاز كروماتغرافيا الغاز وطيافية الكتله & (GC-MS).

أظهر تحليل المستخلص المائي وجود خمسة عشر مكونا يغلب عليها bicycle{10.4.0}hexadecane,14,15di ethyl (39.5%), alpha-d-manofuranoside, methyl (20.08%), Ledol (13. 41%), and lilac aldehyde C (5.58%).

تحليل الزيت الأساسي للشيح أظهر وجود إحدى وسبعين مكوناً يغلب عليها Camphor (14.37%), Isophorone (13.39%), Cinnamic acid, ethyl ester (10.51%), cinnamaldehyde-(E) (6.11%), 1,3-cyclopentadiene,5,5-dimethyl,1,1 diethyl (5.47%) and Methylene (3.70%).

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Chapter One

Introduction

Chapter one

1.Introduction

1.1 Artemisia herba alba: -

*Artemisia herbaalba*is a perennial dwarfshrub, which is a prominent plant of the steppes ofSpain, North Africa and the Middle East (Djamel, et al;2011). The plant belongstothedaisy family (Asteracea). The name *'Artemisia'*comes from the ancient Greek word: *Artemis* =The Goddess (the Greek Queen Artemisia). *Artemisia* is a large, diverse genus of plantranging between 200 to 400 species, these species are known as(desert) in English, (armoise blanche) in French, and (Shih) in Arabic. Willcox (2009) and Hedi, et al; (2010), reported that, there are around 500 species ofArtemisia distributed all over the world. They are frequently employed in folk medicine and food preparations. *Artemisiaherba alba* usuallyfound in dry areas (Mounir, et al ;2015).They are invariably found as small fragrant shrubs or herbs, and most of the fragrantyieldare essential oil. The oils have found uses in perfumery and medicine (Nezhadali, et al ;2008). Most of the *Artemisia* species are perennial, biannual or annual herbaceous ornamental, medicinal and aromatic plant or shrubs. They are silver green, dark green or blue-green in color. Itpossesses pungent smell and bitter taste due to presence of terpenoids and sesquiterpeneand lactones. Some species are cultivated as crops, while, others are used in preparation of tea, tonic, alcoholic beverages and medicines. Apart from non-volatile bioactive compounds, *Artemisia* species are excellent sources of essential oils like thujone, thujyl alcohol, cadinene, phellandrene and pinene, which are reported to possess various biological activities including, anti-bacterial, Anti-fungal, anti-viral, anti-malarial, anti-inflammatory, anti-cancer, and anti-tumor (Bhupendra Koul1, et al ;2017).

1.1.1Plant classification (Caratini 1971)

Kingdom*: Plantae,*

prong*: Angiosperms,*

platoon*: Eudicots,*

Sect*: Asterids,*

Tribe*: Anthemideae,*

Order*: Asterales,*

Family*: Asteraceae,*

Genus*: Artemisia,*

Species*: A herba-alba.*

1.1.2 Description

The *Artemisia herba alba* is green to light green plant with strong, sturdy roots, aromatic, vertical growing with height ranging between 30 to 150 Cm, thickly branch, end with greenish or yellowish vase, with 2 to 4 flower in every vase (Dellile, 2007 , Eldwihy,1996) .Shih plant is peripheral, teeny, spheroidally, with small leaves, feathery, white grayish or sometimes green grayish, silver grayish, lot of small gray roots, interminable with tight slit (Dob

Benabdlkadare,2006; Abou El-Hamad et al;2010). The plant essential oil is greatly demanded by the national and international industrial sectors: aspharmaceutical, food or cosmetics (Omar,2010).

Figure (1.1): The parts of Shih plant (*Artemisia herba alba)*

Source: (marefa.org\ Artemisia cina).

1.1.3 Geographical Distribution:

The plant grows in the arid and semi-arid environments (Djamel, et al;2011), with a rapid growth in dry and warm muddy areas. It is characteristic of the steppes and deserts of the Middle East, extending into Northwestern Himalayas, and India. The various species are more- physiologically different from each other depending on geographical, environmental, and climatic conditions (Djamel, et al;2011), The flowering time is around May/ June then the harvesting start from June and continues until October in some areas (Mounir, et al ;2015). The *Artemisia* species are widely distributed in temperate regions of North America, Mediterranean region, Asia, Africa and Australia. Most species are Imported from Asia, 140-160 from china, 160-170 from EX-USSR, 45-55 from Japan, 30-40 from Iran, 30-45 from India and 15-20 from Turkey. The plant is also utilized as a fodder plant for the livestock in plateau regions of Algeria (Bhupendra Koul1, et al ;2017).

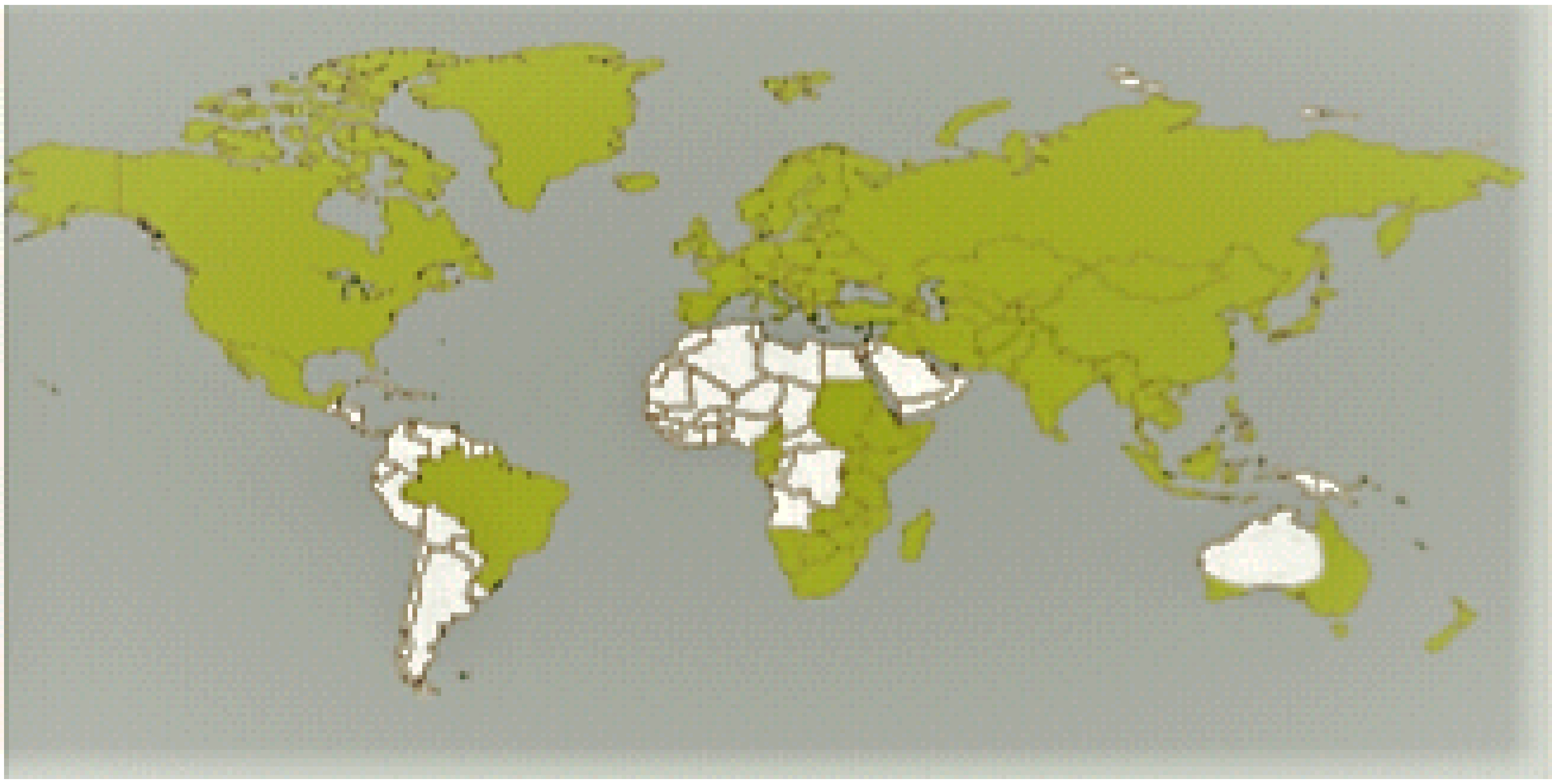

Figure (1.2): Worldwide distribution of the *Artemisia herba alba* species.

Source:(Bhupendra Kaoul, et al;2017).

1.1.4 Types of *Artemisia herba alba*:

1.1.4.1 *Artemisia absinithium:*

This species ofArtemisia is native to temperature regions ofEurasia and northern Africa and widely naturalized in Canada and northern United States. It is grown as an ornamental plant and is used as an ingredient in the spirit absinthe as well as some other alcoholic beverages (Bhupendra Koul1, et al ;2017).

1.1.4.2 *Artemisia abrotanum L:*

Formulations obtained from this species act as an astringent, stimulant, spasmolytic, anti-septic, and febrifuge. The ethanolic extracts of powdered aerial parts has shown anti-fungal and anti-bacterial activities against various fungal and bacterial strains. The active compounds like cineole, borneol, p-cymene. derived from this species also exhibited insect-repellent activity against Aedesaegypti. Essential oil-extracts prepared from the fresh plant material are used as nasal sprays for the treatment of respiratory disorders and allergic rhinitis (Bhupendra Koul1, et al ;2017).

1.1.4.3 *Artemisia annua. L:*

Artemisia annua L. is an annual plant that has a native range from Eastern Europe all the way to Vietnam, but has now naturalized over most of the world. It has a single woody stem that grows about one meter in height (Bhupendra Koul1, et al ;2017). The plant has smaller branches with green leaves that are divided into three leaflets. The flowers grow in small buds with an outer green layer and the inside petals are usually yellow. The leaves, floral buds and flowers also have glandular trichomes where the drug artemisinin is produced and stored (Lommen, et al; 2006).

1.1.4.4 *Artemisia vulgaris:*

Artemisia vulgaris L, which belongs to the genus *Artemisia*, is very much popular due to its characteristic odor and unique medicinal and food flavoring applications (Bhupendra Koul1, et al ;2017). Chemical studies on these plants indicated that there are several classes of bioactive compounds, in particular, terpenoids and flavonoids present in this genus. The presence of essential oils and other terpenoids in the plants of this species can be linked with their potential uses as flavoring agents in foods and as ingredients of pharmaceutical products (Wright, 2002). Vulgaris due to its aromatic nature and distinctive scent, has considerable essential oil potential which can be explored as ingredient of several functional foods, cosmeceuticals, and pharmaceutics. Research on essential oils has been revived due to their potential anti-oxidant and anti-microbial activities against aging, inflammation, and infectious diseases as well as their applications in food science (Hussain, et al; 2008).

1.1.4.5 *Artemisia herba-alba Asso:*

This species is also known as desert wormwood and in Arabic culture it is known as 'Shih'. Since ancient times this plant has been used by the natives of many cultures for the preparations of traditional medicines to treat diabetes and hypertension. Aqueous extracts obtained from aerial parts ofthe plant possess anti-oxidant and anti-microbial properties. Herbal tea prepared from this species exhibits anti-bacterial, analgesic and anti-spasmodic properties (Bhupendra Koul1, et al ;2017).

1.1.4.6 *Artemisia arborescens (Vaill.) L.:*

This is a woody, aromatic, evergreen shrub, which is used in preparation of folk medicines, flavoring dishes and liqueurs. It has also been used as an anti-inflammatory agent in traditional medicines. Several other biological activities such as phyto-toxicity, anti-bacterial and anti-viral properties have also been reported in the plant extracts. Aqueous extract ofaerialparts inhibits the growth ofListeriamonocytogenesandthus exhibits its anti-bacterial potential. The plant essential oils also possess anti-viral activity against Herpes simplex virus (Bhupendra Koul1, et al ;2017).

1.1.4.7 *Artemisia vulgaris Linn:*

This is an important aromatic medicinal species with pungent smell and sharp taste. It has been used to cure epilepsy, depression, irritability, stress and insomnia in folk remedies. In Philippines, this herb is known as ‛herbaka’and is used against hypertensive diseases. In Asia, this plant is widely used for flavoring rice dishes and tea and in western culture it is an important culinary herb. The plant extracts also possess analgesic, allopathic, anti-oxidant, larvicidalcyto-toxic [anti-malarial and anti-hyperlipidemic activity] (Bhupendra Koul1, et al ;2017).

1.1.4.8 *Artemisia capillaris-thunb:*

According to Zoubiri and Baaliouamer, (2014) *Artemisia capillaris* has been used as food additive and as a folk medicine in Korea to cure inflammation, microbial infections, malaria and hepatitis. In traditional oriental remedies, this plant has been used to cure dampness. It is a famous traditional Chinese medicinal herb and is used for the treatment of epidemic hepatitis. This herb contains active ingredients such as capillarisin, apigenin, hesperidin and coumaric acid which are vital for their allelopathic, anti-cancer and anti-microbial properties. Tablets prepared from *Artemisia capillaris* have the potential to inhibit the replication of hepatitis B virus and thus, act as a potent remedy for hepatitis B disease. Many compounds have also been identified from the developing buds of *Artemisia capillaris*. Coumarin andflavonoidsextracted from aerial parts of the plant exhibit significant anti-hepatotoxic property confirmed by carbon tetrachloride-induced liver lesions in cultured rat hepatocytes. It has been reported that β-caryophyllene, β-pinene and capillene obtained from *Artemisia capillaris*representedanti-microbial activity when tested against fifteen different strains of oral bacteria.

An aqueous extract ofdriedplantmaterial exhibits protective effects against oxidative stress. Methanol extract of plant material exhibits an anti-carcinogenic property by suppressing the activation of NF-kappaB (protein complex which controls DNA transcription). Catechins extracted from *Artemisia capillaris* possess a strong anti-oxidant potential. GC-MS and TLC techniques on *Artemisia capillaris* have identified four compounds namely 1-borneol, camphor, achillinandcoumarin with potential anti-carcinogenic property and five other compoundsnamely α-pinene, β-pinene, β-caryophyllene, capillin and piperitone which hold a strong anti-bacterial potential.

1.1.4.9 *Artemisia dracunculus L. (Tarragon):*

Bhupendra Koul1, et al; (2017) reported that *Artemisia dracunculus* is a perennial herb which has long been used in culinary preparations as well as in herbal medicines due to its various health benefits. In Iranian traditional medicines, this herb is famous for its anti-coagulant and anti-hyperlipidimic property. In Arabic cultures, it is used to treat insomnia. In the folk remedies of Azerbaijan, tarragon is used as laxative, anti-epileptic, carminative, and anti -spasmodic agent. In Russia and Central Asia, it has been used intensively for the treatment of allergic rashes, skin wounds, irritations and dermatitis. In the Northern districts of Jammu, Kashmir and Ladakh, thewholeplant extract has also been used in the traditional medicines for the treatment of various fevers and as a vermifuge. The extract obtained from this plant has the potential to decrease the risk of coronary heart disorders in humans. Additionally, it has also been used as an anesthetic for aching teeth, sores and cuts. Two of its main constituents - estragole and methyleugenol are hyperglycemic activitywhen ethanolic extract of the seeds was tested against the diabetic male Sprague-Dawley rats.

1.1.4.10 *Artemisia japonica Thunb:*

This species has been widely used in folk remedies for the treatment of Eczema and fever. Tribal people use various parts such as leaves, stems and aerial parts of the plant because of their wound healing, digestive and depurative properties (Bhupendra Koul1, et al ;2017).

1.1.4.11 *Artemisia indica H. Hara:*

This plant is a perennial herb of the Western Himalayas with local name " Titepati". Chromatographicof *Artemisia iudaica L.* led to the isolation of two new compounds - trans-ethyl cinnamate and piperitone (Bhupendra Koul1, et al ;2017). and is used by the indigenous people to cure the ailments like dyspepsia, chronic fever and other hepatic ailments. In Nepal, the plant juice is used for the treatment of dysentery, abdominal pain and diarrhea. The young leaves of *Artemisia indica* are eaten after cooking with barley and they also provide color and flavor to rice. The tribal people living in Garo eat the tender shoots as vegetable. The people of Okinawa (isolated island of Japan) also use it as a food plantalongwith some other plants. Nepalese use the leaf-juice for the treatment of skin-ailments while the dried leaves and flowers are used as an insect repellent. Volatile oils possess anti-fungal property.

1.1.4.12 *Artemisia Afra Jacq ex Wild:*

Afra Jacq ex Wild is one of the oldest medicinally important plant of Southern Africa. This plant has long been used to cure several diseases such as cold, dyspepsia, headaches, coughs, malaria, diabetes and disorders of kidney and bladder. Now a day it is used to cure various ailments including cough, colds, diabetes, heartburn, bronchial and stomach related disorders. The aqueous leaf-extractsholdsanti-microbial potential against several bacterial strains (Bhupendra Koul1, et al ;2017).

1.1.5 Phytochemistry of *Artemisia herba alba:*

Historically, *Artemisia* has been a productive genus in the search for new biologically activecompounds. Phytochemical investigations have proven that, this genus is rich in sesquiterpenes and monoterpenes (Ahmed et al., 1990; Tang et al., 2000; Tan et al., 1998;and Jiangsu, 1977). The guaianolide structural type is the main sesquiterpene class of this plant. Compounds with fused 5,7,5-ring system have been reported to possess cytotoxic, root-growth (Messai,et al;2008) .Stimulatory two types of oils could be distinguished. These compositionswere dominated by the major compounds camphor, b-thujone or a-thujone, chrysanthenone,chrysanthenyl acetate, or davanone and those characterized by the codominance of two or more of these compounds. For the species growing in semi-arid and arid land, various compositions were observed, dominated either by a single component eg: a-thujone, b-thujone, 1,8-cineole, camphor, chrysanthenone or trans-sabinyl acetate, or characterized by the occurrence, at appreciable content, of two or more of these compounds (Hedi , et al ; 2010) .According to Bhupendra, Pooja et al; (2017) the biochemical investigations have revealed a total of 839 compounds from the different plant parts (leaves, stems and roots) of *Artemisia* species.

These species mainly comprise of terpenoids, flavonoids, coumarins, caffeoylquinic acids, sterols and acetylenes. The hydrocarbons and oxygenatedterpenesarethemostabundantcompoundsfound in the genus *Artemisia*. These are mostly: (1) acyclic monoterpenes (citronellol, myrcenol, linalool, *Artemisia* alcohol). (2) monocyclic monoterpenes (menthol α-terpinene, p-cymene, terpinen-4-ol.). (3) bicyclic monoterpenes vizcamphanes (borneol, camphor) pinanes (α-pinene, myrtenol, myrtenal, (α-thujene, sabinene, sabinaketone). (4) acyclic sesquiterpenes. farnesanes (farnesal, farnesol). (5) monocyclic sesquiterpenes. bisabolanes (α-bisabolol, Cis-Lancelot), germacranes (germacrene A, germacrene B, germacrene C, germacreneD). The various classes of compounds reported here possess several pharmacological properties. Limonene, is a monoterpene and has many medical and pharmaceutical applications, like anti-carcinogenic actions, in liver tumor models and as topical medication for both dermal and sub-dermal injuries (Singh et al., 1989).Another monoterpene p-Cymene has shown significant anti-oxidant and anti-microbial activities .The next major class of compounds are the flavonoids apigenin, luteolin, chrysoeriol, cirsiliol, kaempferol, rhamnocitrin, quercetin, tamarixetin, mikanin, casticin, cirsilineol, eupatin, mearnsetin, chrysosplenolE,in addition flavonoid glycosides, kaempferol-3-O-glucoside, isorhamnetin 3-glucoside, which belongs to a large group of phenolic secondary metabolites of plants .The later compounds are extensively studied. They have been evidenced to antioxidative activity. Moreover, partial structure-activity relationship has been studied, demonstrating that the ability ofanti-oxidative activity isrelevant to the structure of sugar moiety. The phenyl propanoidsanethole, eugenoland methyl eugenol, are produced by the shikimate pathway, which is unique to plant.

Many other compounds like cyclic and acyclic hydrocarbon, alkynes, lignans, cyaromatic acids, saturated and unsaturated fatty acids, alcohols, ketones, and esters were isolated from *Artemisia*. Several pure compounds were evidenced to perform biological action. The isolated constituentshave been identified using various techniques like GC-MS, HPLC-MS, HPLC, 1D and 2D NMR, and X-ray crystallography.

1.1.6 Minerals content:

Minerals comprise only about (4–6%) of the human body, but they have initial importance in the diet. Trace elements play a very important role in the formation of the active chemical constituents in medicinal plants and are therefore responsiblefortheirmedicinal as well as toxic properties (Amar,et al ;2014). The major minerals are thoserequiredin amounts greater than 100 mg per day and they represent 1% or less ofbody weight. These include calcium, phosphorus, magnesium, sulfur, potassium, chloride, and sodium. The trace minerals are essential in much smaller amounts, (less than 100 mg per day). The essential trace elements include zinc, iron, silicon, manganese, copper, fluoride, iodine, and chromium. The major minerals serve as structural components of tissues and function in cellular and basalmetabolismand water and acid–base balance (Smith, et al;1988). However, despite their widespread use, safety and quality issues have been major concerns in the world due to industrial- and anthropogenic-based heavy metal contamination risks. There is a growing interest in the mineral content offoods and diets. The trace elements found in plant may be essential, that is, indispensable for growth and health, or they may be non-essential, fortuitous reminders of our geochemical origins or indicators of environmental exposure. It was reported that green leaves are good sources of calcium. From antiquity, in addition to Artemisia spices and their derivatives being used for flavoring foods and beverages andformedication, they have also been highly valued for their use as antimicrobials. Human, as well as animal, studies originally showed that optimal intake ofelements, such as sodium, potassium, magnesium, calcium, manganese, copper, zinc, and iodine, could reduce individual risk factors, including those related to cardiovascular disease. Throughout the world, there is increasing interest in the importance of dietary minerals in the prevention of several diseases (Smith, et al ;1988).

1.1.7 *Artemisia herba alba* uses:

1.1.7.1 Traditional uses:

Shih plant is widely used in the traditional medicine to treat bronchitis, diarrhea, hypertension and neuralgia. Herbal tea from these species have been used as analgesic, anti-bacterial, anti-spasmodic, and hemostatic agents (Messai, et al;2008). The essential oil of this species was known for its therapeutic disinfectant, anti-thelminthic and anti-spasmodic virtues (Hedi, et al;2009). *Artemisia* genus harbors as important medicinal plant species have been used since ancient times for pharmacological and certain culinary purpose (Bhupendra Koull, et al ;2017). The aerial parts of the plant exhibited anti-microbial potential when tested with Saccharomyces cerevisiae and Candida albicans. The use of plants in treatments has been as old as humanity and it has preserved its popularity for centuries till now because of their availability, affordability and safeness.

1.1.7.2 Nutritional uses:

Artemisia have been used in folk medicine by many cultures since ancient times (Djamel, et al;2011). Anti-microbial and anti-oxidants are added as feed additives to broiler diets to enhance intestinalhealth and to improve food safety and quality. In Nepal, the plant juice is used for the treatment ofdysentery, abdominal pain and diarrhea. The young leaves of *Artemisia* are eaten after cooking with barley and they also provide color and flavor to rice. Nepalese use the leaf-juice for the treatment of skin-ailmentswhile thedried leaves and flowers are used as an insect repellent. Volatile oils such as β-thujone, herniarin, 1, 8-cineol, estragole, sabinyl acetate. Because ofthe growing consumer concern about the use of anti-microbialand the banofmost anti-biotic feed additives in the European Union, there is elevated interest in using alternatives to anti-microbial in poultry diets. For these reasons, the use of phytogenic or plant based feed additives or botanicals in ration formulation is gaining popularity (Djamel, et al;2011).

1.1.7.3Medicinal and Pharmaceuticaluses:-

Investigations on the medicinal properties of *Artemisia herba alba* extracts reported:leishmanicidal,antifungal properties (Mounir, et al;2015). The essential oil of this species was known for its therapeutic disinfectant, anti thelminthic and anti-spasmodic virtues (Hedi, et al;2009). *Artemisia herba alba* could constitute a good adjutant to combat obesity, hyperglycemia, hypertriglyceridemia, hypercholesterolemiaand particularlyoxidative stress. The aqueous extract of the aerial partfromArtemisia *herba-alba*showed considerable lowering of serum totalcholesterol, triglycerides, low-density lipoprotein, and an increase in high-density lipoprotein in alloxan-induced diabetic rats (Omar,2012). The plant is rich in terpenoids, flavonoids, coumarins, acetylenes, caffeoylquinic acids and sterols. It was shown that Artemisia has multiple beneficial bioactivities: antimalarial, anti-viral, anti-tumor, anti-pyretic, anti-hemorrhagic, anti-coagulant, anti-angina, anti-oxidant, ant hepatitis, anti-ulcer genic, antispasmodic and anti-complementary activities (Djamel, et al;2011). *Artemisia* was also reported to include, anti-bacterial , anti-viral , anti-inflammatory , anti-cancer , anti-tumor , anti-helminthic , anti-diabetic, anti-spasmodic,hepatoprotective , anti-pyretic , anti-parasitic,anti-fertility ,acaricidal , anti-rheumatic , anti-hypertensive , trypanocidal, trichomonacidal, wormicidal ,emmenagogue, diuretic, abortive ,anti-arthritis ,immunomodulatory ,neuroprotective , menopause, premenstrual syndrome, dysmenorrhea and attention deficit hyperactivity disorder anti-ulcerogenic analgesic (Saxena, 2015).It was reported the plant is anti-nociceptive ,anti-plasmodial, anti-venom , anti-coccidal , anti-leishmanial , anti-hyperlipidemic , anti-epileptic and anti-convulsant , anti-cholesterolemic, cholagogue, diuretic, febrifuge and vasodilator ,deobstruents , disinfectant, choleretic, balsamic, depurative, digestive, emmenagogue, and anti-leukaemia and ant-sclerosis , vermifuges, febrifuge, anti-biotic, urine stimulant ,anti-migraine , insecticidal , anti-feedant ,abortifacient , anti-herpes virus ,and antidote to insect poison (Bhupendra Koul1,et al ;2017).

Malaria is a dangerous disease, especially common in tropical areas, which are quite often developing countries. InChinait was used to treat multiple ailments. In more modern history, an extract of the plant called artemisinin was recognized as an effective anti-malarial medicine. Antibiotic resistance in bacterial species is opening newavenues to searchfor alternative modes of antimicrobial treatment, so the medicinal plant extracts being one among that. The possibility of medicinal plant extract from Shihin the manufacture of pharmaceutical preparations for oral hygiene specifically for the prevention and treatment of dental caries due to Streptococcus mutants. Anti-microbial effects of crude organic extract of Shih (Mohammed, et al ;2018).

1.1.8 Essential Oil of *Artemisia herba alba:* -

The essential oil yield of *Artemisia herba alba* was reported to be about 0.4 to 1.19% w/ w (Nezhadali, et al ;2008). A total of 61 components was identified by GC-MS, representing 98% of the oil). Two types of oils were being distinguished: (i) oils with a composition dominated by major compounds, camphor, a-thujone, b-thujone, chrysanthenone, chrysanthenyl acetate, or davanone, and (ii) oils characterized by the occurrence at appreciable contents oftwo or more ofthese compounds. Various compositions containing two, three, or more of the aforementioned components at appreciable contents (25–50%) were also reported (Nezhadali, et al ;2008). Someofthese constituents were reported as chemo types, thus, the number of chemo types increased considerably. However, they might also be considered as intermediates or subtypes (He´dimighri,et al ;2010) . In Spain, essential oil from *Artemisia herba alba* showed that, monoterpene hydrocarbons and oxygenatedmonoterpenes are themost abundant skeletons, but large amounts of sesquiterpenes were also found in some populations. Camphor, 1,8-cineole, p-cymene and davanone were the major chemical compounds. InJordan, regular monoterpeneswere predominant and the principal components were α- and β-thujones, classifying the *Artemisia herba alba* as beinga thujones chemo type. In Morocco, sixteen chemo types were found, with twelve of them have mono terpenes as major components of theessential oils. The remaining four chemo types, have sesquiterpene skeletons as the major fraction. In

Algerian essential oil, monoterpenes were the major components, especially camphor, α-and β-thujones,1,8-cineoleand chrysanthenyl derivatives. The oil contains 10 components with percentages higher than10%, In Tunisian oil, oxygenated monoterpenes were found to be the major components ofArtemisia *herba albaoil*extracted from aerial parts (Mounir, et al; 2015). Haouari, et al; (2009) reported that, the oil yield varied between 0.68% v/w and 1.93% v/w, based on dry weight of the samples. Onehundred components, accounting for 93.5% to

100% of the oil, were identified, 75 of them being reported for the first time in Tunisian oil, and 21 ofwhich have not been previously reported in Artemisia herba-alba oils. Among the hundred identified components, ten of them (cineole, thujones, chrysanthenone, camphor, borneol, chrysanthenyl acetate, sabinyl acetate, davana ethers and davanone) could be considered as major components, with concentrations superior to 10% of the total oil. Camphor was found at high concentrations. High levels ofborneol were found in oil. The main sesquiterpenes found in the studied oil are davana ethers and davanone. Several davana ether isomers were identified.

1.2 *Artemisia* and COVID-19:-

1.2.1PhytotherapyResearchReport, (2020): -

In December 2019, an increasingnumber of cases of novel coronavirus, designated SARS-COV-2, has causedworldwide outbreak of respiratory infection, now termed coronavirusdisease 2019 (COVID-19) (Cao et al., 2020). As of March 26, 2020, coronavirus disease 2019 (COVID-19) has been confirmed in 462,684 people andthedeathhadreached over 20,834 globally (WHO, 2020). Until yet, there are no vaccine and no specific antiviral agents for coronavirus infections (Faiz, et al;2020).

The traditional Chinese medicines demonstrated preliminary efficacy against SARS-COV, the virus that causes SARS in humans (Dong, et al; 2020). The researcher tested anti-viral activities of *Artemisia* whole plants preparation in ethanolic extract against SARS-COV, with 50% effective concentration (EC50) value of 34.5 ± 2.6 μg/mL and 50% cytotoxic concentration (CC50) of 1,053 ± 92.8 μg/mL (Li, et al; 2005).

Artemisinin is a derivatives of *Artemisia* that have been commercialized as anti-malarial drugs (Efferth, et al; 2008). The value of artemisinin is not limited to the treatment of malaria, it is most promising natural products that is important candidates accounting for the anti-viral effects (Karamoddini,et al;2011).

*Artemisia*was reported to contain sterols that showvirus inhibitory potential (Khan, et al; 1991).

The subset methanolic extracts obtained from aerial parts of *Artemisia* plant had the highest anti-viralactivitythanacycloviragainstHerpes Simplex virus type 1. Aerial subsetsextractsof Artemisiacontain bioactive compound that may be an appropriate candidate for anti-viral therapies (Karamoddini, et al; 2011).

Pulmonaryfibrosis isobserved in SARS coronavirus-2 (SARS- CoV-2) infection with increased severity, mediated by Interleukin-1 (Conti, et al;2020).

Several studies suggesting that oxidative stress is associated with pulmonary diseases and it is likely that the consumption of natural anti-oxidant is effective in lung fibrosis (Day, 2008).

Artemisia extracts exhibit significantanti-oxidant activity that is most likely due to it's high phenolic content (Ferreira, et al; 2010).

Artemisia derivatives, artesunate, is a promising novel drug to treat pulmonary fibrosis by inhibiting profibrotic molecules associated with pulmonary fibrosis (Wang, et al; 2015).

1.2.2 The France National Academy of Medicine,Report(2020): -

The announcement of the President of Madagascar on 20 April 2020 about the effectiveness of the "Covid-Organics" was widely covered by the media. It's an herbal tea or decoction based on *Artemisia*, developed by the Malagasy Institute for Applied Research (IMRA). Distributed in 33 cl bottles or in dry herbal sachets under the brandname "CVO Tambavy", it contains 62% *Artemisia* and a mixture, in confidential proportions, ofMalagasymedicinal plants used in the composition oftraditional remedies as antiseptics and bronchial fluidizers.

The National Academy of Medicine, Noting: -

- The lack of data on the molecules present in the dry matter of *Artemisia* produced in Madagascar.
- The absence of a preliminary study demonstrating antiviral activity of artemisinin in relation to SARS-COV-2 in vitro.
- The lack of proof of concept and the empirical nature of the proposed therapeutic protocol.
- The lack of controlled clinical studies of tolerance and efficacy.

(Danis M, 2019).

1.2.3 The American Society ofTropicalMedicine and Hygiene, Report (2020)

The world is currently facing a novel COVID-19 pandemic caused by SARS-COV-2 that, as of July 12, 2020, has caused a reported 12,322,395 cases and 556,335 deaths (WHO). Till now, only two treatments, remdesivir and dexamethasone, have demonstrated clinical efﬁ cacy through randomized controlled trials (RCTs) in seriously ill patients.

Of several recentandongoing treatment intervention trials, only two randomized controlled trials have to date demonstrated beneﬁ ts of speciﬁ c therapies.

Onestudyindicated thathospitalized COVID-19 patients who received remdesivir had a 31% faster time to recovery than those who received placebo(NIH,2020). Another trial reported that dexamethasone reduced mortality by one third in seriously ill patients requiring respiratory support (Horby,et al ; 2020). Of note, dexamethasone was previously shown to be effective in the treatment of ARDS. Among other drugs initially considered of promise, trials of chloroquine or hydroxyl choloroquine plus lopinavir/ritonavir with or without azithromycin have shown no reduction in mortality in hospitalized patients.

Results of a small clinical study from China of artesunate, a hemi-synthetic derivative ofartemisininforthetreatment of COVID-19. The artesunateinhibit the replication ofviruses or the inﬂ amatory response in vitro. These suggest that artesunate may offer both antiviral and anti-inflammatory effects at clinically achievable concentrations (Paulin, et al; 2020).

InApril 2020, an herbal tonic derivedfromArtemisiaextracts by the MadagascarInstitute of Applied Research and branded "COVID-Organics" was launched. COVID-Organics has been promoted as a cure for COVID-19. However, reliable pharmacological and efﬁ cacy data are lacking, and there is concern that its widespread use for COVID-19 could result in reduced access to effective medicines as well as possible selection of P. falciparum resistance to ACTs by exposing patients to suboptimal concentrations of artemisinin when malaria cases are misdiagnosedas COVID-19. Of note, the content of artemisinin in *Artemisia* is about 1%, which means that 50 g of plant materials needed to obtain the equivalent of a 500-mg therapeutic doseof artemisinin,if considering a 100% extraction (Van Der,et al,2011). Furthermore, the typical concentration ofartemisinin in infusions is around 50 mg/L; 10 L must be ingested to absorb the anti-malarial therapeutic dose, which is not feasible. Therefore, to avoid the promotion of unproven remedies in this climate of uncertainty andfear, it is important that researchinto traditional medicinal plants and their derivatives be conducted properly.

Theû avonoidscasticin and chrysosplenol D, extracted from *Artemisia*, suppressed the expression of inû ammatory mediators, suggesting that these components might be useful in the treatment of inû ammatory and infectious disorders (Li YJ, et al; 2015).

Finally, it is important to emphasize thatthere are no controlled data supporting the use of any of these, and their efû cacy for COVID-19 is unknown. Arguably, natural product research is only relevant to the development ofnew drugs as aû rst step to identifying speciû c molecules with activity. Teas cannot function as drugs meeting international standards, as their components are unknown and not standardized (Van Der, et al; 2013). Advancing traditional medicines will require identû cation of active components of plant extracts, methods to yield purû ed compounds, and determination of compound pharmacology including studies of biological activity, bioavailability, absorption, distribution, metabolism, excretion, and toxicity properties ofeach molecule. For evaluation of the anti-viral effects of herbal formulations, the screening system should meet all requirements of any good assay, including validity, lack of ambiguity, accuracy, reproducibility, simplicity, and reasonable cost. Because

Theserequirementsarebetter met byin vitro screening; in vitro bio assays must be used to guide the isolation of active compounds from plant extracts. The antiviral activities of the pure compounds must then be confirmed at a later stage by in vivo assays in appropriate animal models.

Objectives of the study: -

1. To determine the Minerals content of *Artemisia herba alba* by inductively coupled plasma (ICP).

2. To study the aqueous extractableingredientsofArtemisia *herba alba* using Gas Chromatography- Mass Spectroscopic analysis (GC-MS).

3. To extract Shih essential oil and measure the oil yield percentage.

4. To investigate the Chemical Composition of the extracted oil using Gas Chromatography- Mass Spectroscopic analysis (GC-MS).

5. To compare the obtained results with those of the previous studies in this field.

Chapter Two

Materials and Methods

Chapter two

2. Materials and Methods

2.1 Collection of sample:(one sample has been analyzed**)**

Dry *Artemisia herba alba* sample was purchased from Omdurman market(Sudan).

2.2Chemicals: -

- Hydrochloric acid (35%).Mumbai-India. Product No.38507
- Anhydrous Sodium sulphate (Hopkins and Williams LTD) -England
- Ethanol (99.9%), Duksan pure chemicals productNo.4150-France

2.3 Instruments: -

- Distillation unit (240 V /500 W). Electrochemical LTD.
- Muffle furnace RS solution serial No.21-100122, type cwf
- soxhelet extraction system.
- Inductively coupled plasma(ICPE-9000) (shimadzu)
- Gas chromatography Mass spectroscopy (GC-MS-QP2010-Ultra)

2.4 Methods of analysis:

2.4.1 Determination ofShih minerals content (ICP analysis):

1g of the aerial part of Shihsample was taken into porcelain crucible.The sample was burned inopen flame for 30 minutes and then ignited intoa muffle furnace at 650 C^0 for 2 hours.The ashwas dissolved in 3 ml of hydrochloric acid (10%) and the volume wascompleted to 10 ml in a volumetric flask by deionize water, then the solution passed through ICP instrument to measure minerals content in Shih.

2.4.2 Aqueous extraction of Shih plant: -

100 gramofthe aerial part of Shih plant were introduced to a soxhelet extraction system fitted with a500 ml three-necked round bottom flask and condenser, using 300 ml of water. After 3 hours, the solvent was removed under vacuum at (40-60). The extract obtained was analyzed by GC-MS.

2.4.3 Essential oil extraction: -

100g of thedryShihsample were accurately weighed and transferred to distillation unit.500 ml of distilled waterwere added, andcontents were distilled for four hours. The distilledvolatileOilwas separated and analyzed by (GC-MS) to determine the chemical composition of Shih Essential oil.

2.4.4 GC-MS analysis ofShih aqueous extract:

10 ml of the aqueous extract were dissolved in 1ml ofEthanol. 0.1g ofanhydrous sodium sulphate was added.The solution was diluted to 20 ml by distilled water.5µl of the solutionwas passed through syringe filter and injected into the GC-MS instrument.

2.4.5 GC-MS analysis of Shih Essential oil:

1 ml of oil was dissolved in 1ml of Ethanol, then 0.1g of anhydrous sodium sulphate was added, the solution wasdiluted to 20 ml bydistilled water, 5µl of the solution was passed through syringe filter and injected into the GC-MS instrument.

2.4.6 GC-MS Conditions

The qualitative and quantitative analysis of the sample was carried by using GC-MS instrument model (GC-MS-QP2010-Ultra) from japans 'Shimadzu Company, with serial number 020525101565SA and capillary column (Rtx-5ms-30m× 0.25 mm× 0.25µm). Thesamplewas injected by using split mode, instrument operating in EI mode at 70eV. Helium as the carrier gas passed with flow rate 1.69 ml/min, the temperature program was started from 50c with rate 7c/min to 180c then the rate was changed to 10c/min reaching 280c as final temperature degree, the injection port temperature was 300c.The ion source temperature was 200c and the interface temperature was 250c.The sample was analyzed by scan mode in the range of m/z 40-500 charges to ratio and the total run time was 28 minutes. Identification ofsample constituents was achieved by comparing their retention index and mass fragmentation with those available in the library, according to National Institute ofStandards and Technology (NIST)., results were recorded.

Chapter Three

Results and Discussion

Chapter Three

3. Results and Discussions:

3.1 Inductively coupled plasma analysis(ICP):-

Table (3.1) Macro minerals content of: ***Artemisia herba alba*–**

Mineral	concentration
p	11mg/l
Ca	0.43mg/l
Mg	**0.58mg/l**
Na	**0.32mg/l**
K	0.19mg/l

Phosphorus was found to be the most available macro mineral(11mg\l).

Theminerals Ca,Mg,Na,and K were found in (µ g/l) level. Magnesium was (580 µ g/l), followed by Calcium (430µ g/l), Sodium (320µ g/l), and Potassium (190 µ g/l).

The plant *Artemisia herba alba*may be described as poor source for micro mineral content.

Table (3.2) Trace minerals content of *Artemisia herba alba*: -

Mineral	concentration
Fe	25 mg/l
S	21 mg/l
Al	6.1 mg/l
I	2.8 mg/l
Si	1.1mg/l
Rb	370 mg/l
Mn	0.62mg/l
Cu	0.36mg/l
Ti	0.25mg/l
Ir	0.098 mg/l
Ni	0.086 mg/l
Zn	0.080mg/l
Os	0.064 mg/l
Re	0.045 mg/l
Se	0.044 mg/l
Hf	0.041mg/l

Table (3.2) shows theavailabilityofsometransition and inner transition minerals in a wide range. The concentrations of the Fe, S, AL, I and Si was found in mg/l. the Iron was the most available trace mineral (25 mg/l), followed by Sulfur (21mg/l), Aluminum (6.1mg/l), Iodide (2.8mg/l) and Silicon (1.1mg/l). but it may be an indicator to the nature of soil composition.

Some of these minerals may be isolated from the aerial part aqueous extract for scientific purposes. However, the presence of all these minerals may indicate the high ability of the plant roots to absorb inorganic minerals.

The concentration ofMn,Cu,Ni,Zn,Se and Ti was found in µg/l.

Manganese was found (620µg/l) followed by Copper (360µg/l), Nickel (86 µg/l), Zinc (80µg/l) and selenium Se (44µg\l).

Titanium (Ti), as one of the most available trace Mineral in the earth crust showed relatively high concentration (250µg/l).

Some typically trace minerals which have no nutritional important were also shown, these include Iridium Ir (98µg\l), Osmium Os (64µg\l), Trillium Te (42µg\l), Hafnium Hf(41µg\l), IndiumIn (37µg\l), Tedium Ta (23µg\l), Ruthenium Ru (16µg\l), and GalliumGa (6.6 µg\l).

From nutritional sight ofview*Artemisia herba alba* may be described as rich in

Iodine as very essential minerals for human health showed considerably high concentration (2.8mg/l).

Table (3.3) Toxic minerals content of *Artemisia herbaalba*:-

Mineral	concentration
Pb	0.092mg/ l
As	**0.046**m**g/ l**
Sn	**0.025**m**g/ l**
Sb	**0.024**m**g/ l**
Ba	0.0089mg/ l
Sr	0.0065mg/ l
Cd	0.0051mg/ l
Ag	0.0032mg/ l
Hg	**0.0026**m**g/ l**
Be	**0.0017**m**g/ l**

Table (3.3) showed the availability of some toxic minerals in *Artemisia herba alba*, but at very low concentration level(µg/l).

However Pb,Sb,As, Sn and Ba showed different concentration compared with the other toxic minerals .The most hazardous minerals Cd and Hg showed significantly, low occurrence .

Lead was the most available toxic mineral (92µ g\l), followed by Arsenic As(46µ g\l) , Tin Sn(25µ g\l), Antimony Sb(24µ g\l), Barium Ba(8.9µ g\l), Strontium Sr(6.5µ g\l), and Cadmium Cd(5.1µ g\l).

The lowest concentrations were shown by Silver Ag(3.2µ g\l), Mercury Hg(2.6µ g\l), and Beryllium Be(1.7µ g\l).

The relativelylowavailabilityofthose toxic minerals may be a part of the toxic effects of the *Artemisia herba alba*.

Table (3.4) Rare earth elements content of *Artemisia herbaalba*:-

Mineral	Concentration
Er	0.55mg/ l
Th	**0.14mg/ l**
U	**0.037**m**g/ l**
Tm	0.018mg/ l
Nd	**0.011**m**g/ l**
Ce	0.010mg/ l
Gd	**0.0088**m**g/ l**
Sm	0.0062mg/ l
Pr	**0.049**m**g/ l**
Tb	0.0042mg/ l
Dy	0.0029mg/ l
Eu	**0.00035**m**g/ l**

The ICP analysis showed trace level availability of some **Lanthanides and Actinides minerals.**

However, Erbium was the most available lanthanides Er(0.55mg\l), followed by Thorium Th(0.14mg\l), and Uranium U(0.037m g\l) as most available actinides respectively.

In general *Artemisia herba alba* can be described to be a good a source for wide range of Minerals.

3.2Chemical composition of Shih aqueous extract:-

GC-MS analysis oftheaqueous extract of the aerial part of Shih{Fig 3.1 and table 3.5} showed the presence of fifteen constituents, dominatedby, bicycle {10.4.0} hexadecane,5(39.5%)., alpha-d-manofuranoside, methyl (20.08%)., Ledol (13. 41%).lilac aldehyde C (5.58%)., as major constituents.

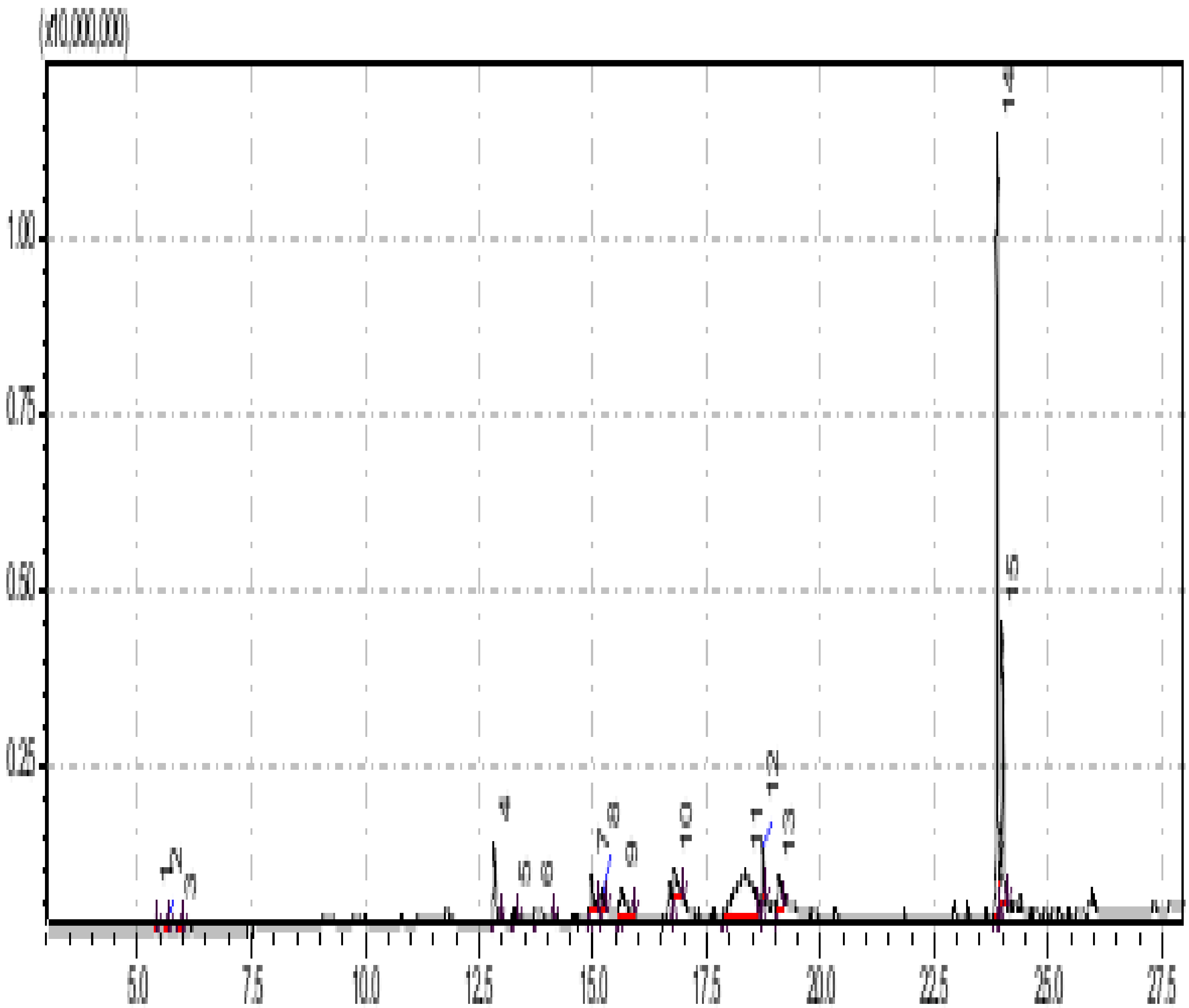

Figure (3.1) Profile ofGC-MS separation chromatogram of Shih aqueous extract.

(3.2.1): Major components of *Artemisia* aqueous extract.

3.2.1.1 Ledol ($C_{15}H_{26}O$).

Ledol is a poisonous sesquiterpene that can cause cramps, paralysis, and delirium.

Ledol is also found in the essential oil of priprioca at a concentration of around 4%,and other plants such as *Cistus ladaniferus* ,*Eucalyptus albens* and *Piper cubeba*.

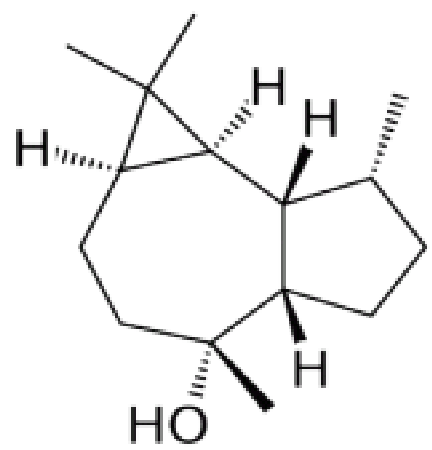

Figure (3.2.1.1): Ledol structure ($C_{15}H_{26}O$).

3.2.1.2 Methyl D-glucoside($C_7h_{14}O_6$)

Methyl D-glucoside is a monosaccharide derived from glucose, it can be prepared in the laboratory by the acid-catalyzed reaction of glucose with methanol. It is used as a chemical intermediate in the production of a variety of products including emollients, emulsifiers, humectants, moisturizers, thickening agents, plasticizers, surfactants, varnishes, and resins. The formation of methyl glycoside indicates that the structure of glucose is not open chain.

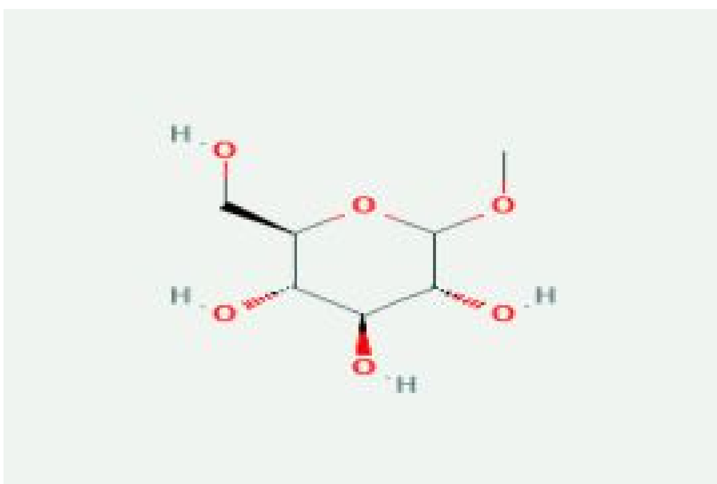

Figure (3.2.1.2): Methyl D-glucoside structure($C_7h_{14}O_6$)

3.2.1.3 Lilac aldehyde($C_{10}H_{16}O_2$)

Lilac aldehyde is an aldehyde found in tea. Fliederaldehyde is isolated from bergamot oil.

Insoluble in water, soluble in Ethanol. It used as Flavoring Agents.

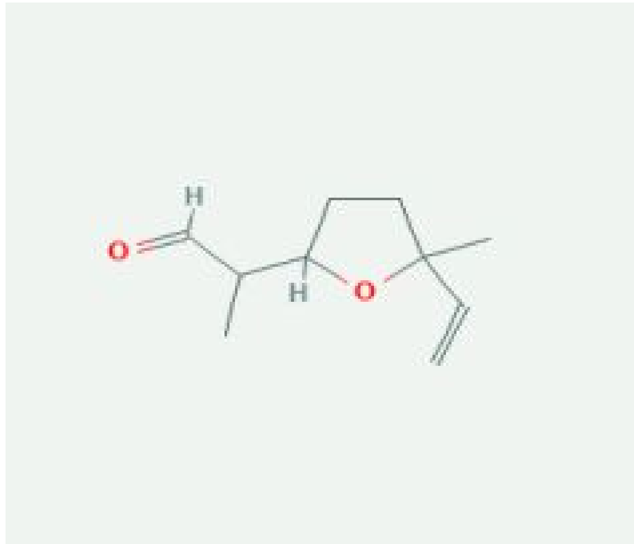

Figure (3.2.1.3): Lilac aldehyde structure ($C_{10}H_{16}O_2$)

Table 3.5: Chemical composition ofShihaqueousextract:

	Name	Ret.Time	Area	Area%
1.	Benzene, 1,2,3-trimethyl-	5.371	96452	0.12
2.	2-Cyclopenten-1-one, 2,3,4,5-tetramethyl-	5.597	128305	0.16
3.	Benzene, 1,2,4-trimethyl-	5.908	161490	0.21
4.	Lilac aldehyde C	12.823	4367982	5.58
5.	2-Butenoic acid, 2-methyl-, 2-(acetyloxy)-1,1a,2,3,4,6,7,10,11,11a-decahydro-7,10-dihydroxy-1,1,3,6,9-pentamethyl-4a,7a-epoxy-	13.272	757812	0.97
6.	2-Methoxy-4-vinylphenol	13.759	2149574	2.75
7.	1,7-Dioxaspiro[5.5]undec-2-ene	14.958	2498237	3.19
8.	1,3-Dimethyl-2-oxocyclohex-3-enecarboxylic acid, methyl ester	15.196	1137190	1.45

9.	Cyclopentanecarboxylic acid, 3-isopropylidene-, bornyl ester	15.614	3083438	3.94
10	Cyclohexanone, 2-butyl-	16.789	2311604	2.95
11	.alpha.-d-Mannofuranoside, methyl	18.343	15718984	20.08
12	Cyclopropane, 1-(1-hydroxy-1-heptyl)-2-methylene-3-pentyl-	18.716	1616918	2.07
13	2H-1-Benzopyran-2-one, 7-methoxy-	19.066	2834040	3.62
14	Bicyclo[10.4.0]hexadecane, 14,15-diethyl-	23.865	30923917	39.50
15	5.beta.,7.beta.H,10.alpha.-Eudesm-11-en-1.alpha.-ol	23.971	10493534	13.41

According to obtained results, {figure 3.1 and table 3.5}, Esters, Hydrocarbons, Terpenes and Aromatic compounds were most major components in aqueous extract of the *Artemisia herba alba*plant.

Unsaturated components also show relative presence in the aqueous extract of the Shih plant.

According to Bhupendra, Pooja, et al; (2017) the biochemical investigations have revealed a total of 839 compounds from the different plant parts (leaves, stems, roots) of *Artemisia* species. These species mainly comprise of terpenoids, flavonoids, coumarins, caffeoylquinic acids, sterols and acetylenes. The hydrocarbons and oxygenatedterpenes are the most abundant compounds found in the genus Artemisia. These are mostly: (1) acyclic monoterpenes (citronellol, myrcenol, linalool, Artemisia alcohol). (2)

monocyclic monoterpenes (menthol α-terpinene, p-cymene, terpinen-4-ol.). (3) bicyclic monoterpenes vizcamphanes (borneol, camphor) pinanes (α-pinene, myrtenol, myrtenal, (α-thujene, sabinene, sabinaketone). (4) acyclic sesquiterpenes. farnesanes (farnesal, farnesol). (5) monocyclic sesquiterpenes. bisabolanes (α-bisabolol, Cis-Lancelot), germacranes (germacrene A, germacrene B, germacrene C, germacrene D).

3.3 Chemical composition of Shih essential oil –

The essential oil yield was 0.69 ml\100g.

The GC-MS analysis of Shih plant essential oil {Fig 3.2 and table 3.6} showedthe presence of seventy-one constituents, dominated by Camphor (14.37%), Isophoron(13.39%) ,Cinnamic acid, ethyl ester(10.51%), cinnamaldehyde-(E)(6.11%), 1,3-cyclopentadiene,5,5-dimethyl,1,1 diethyl(5.47%), Methylene(3.70%), Isophorone(2.18%), as most major constituents.

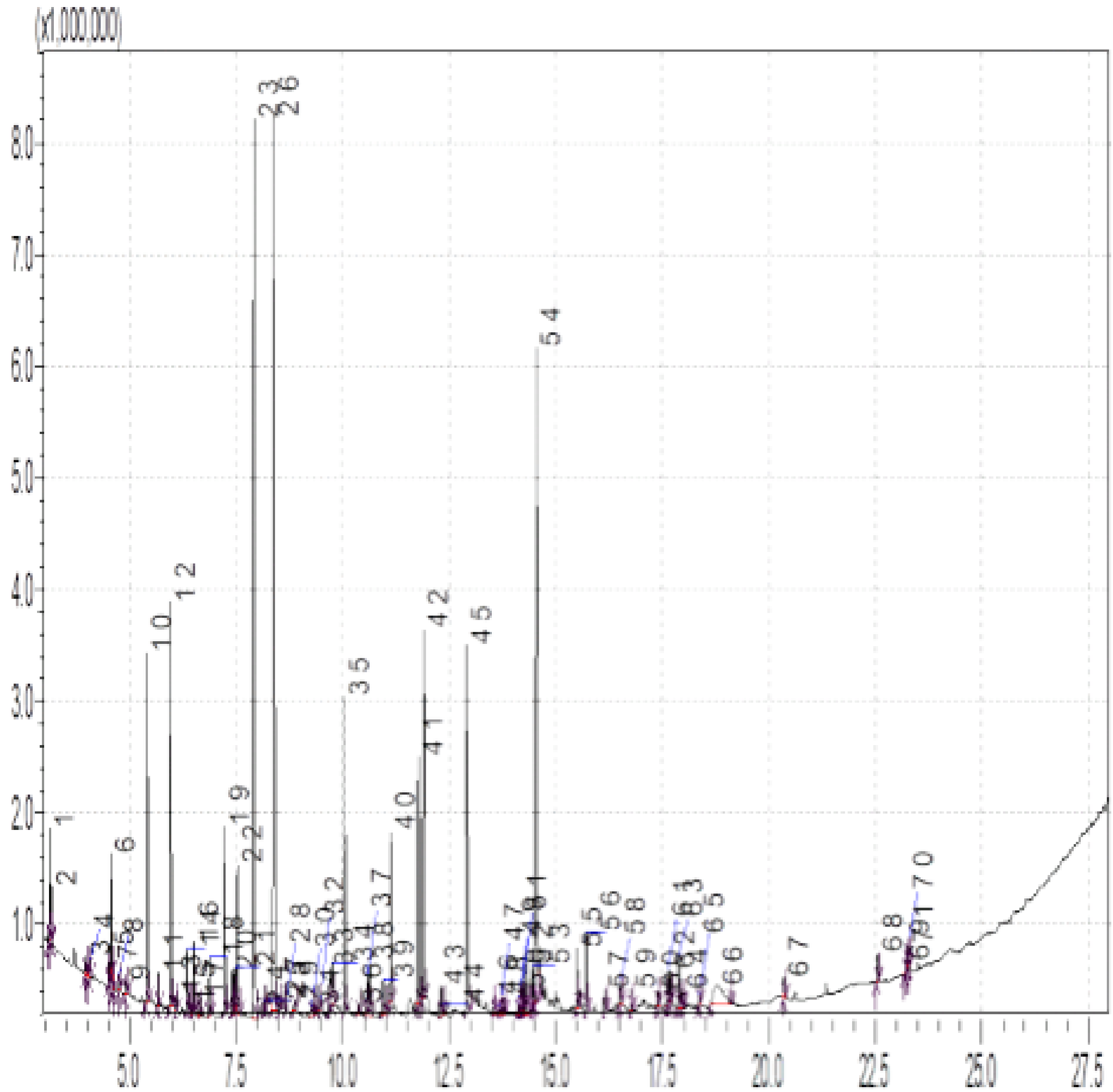

Figure (3.3): Profile of GC-MS Separation chromatogram of Shih Essentialoil.

3.3.1:Major components of Shih Essential oil:

3.3.1.1 Camphor:

Camphor mainly extracted from laurel trees (*Cinnamonum camphora*) that were abundant in the region. Is believed to be toxic to insects and is thus sometimes used as a repellent, Camphor is also used as an anti-microbial substance, camphor oil was one of the ingredients used by ancient Egyptians for mummification.

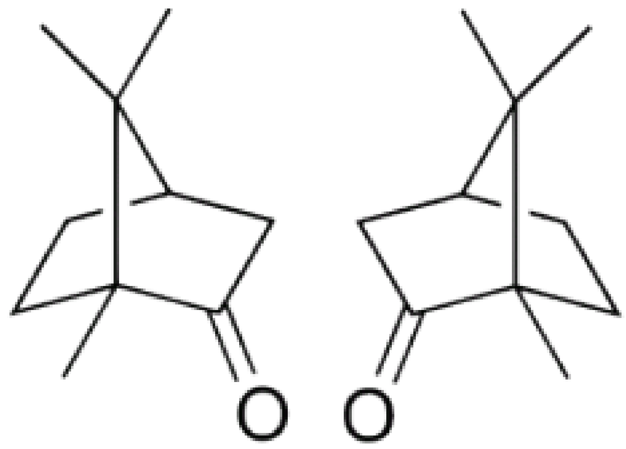

Figure (3.3.1.1): (+)- and (−)-camphor structure($C_{10}H_{16}O$)

3.3.1.2: Isophorone ($C_9H_{14}O$)

Isophorone occurs naturally in cranberries. It undergoes reactions characteristic of an α,β-unsaturated ketone, The use of isophorone as a solvent resulted from the search for ways to dispose of or recycle acetone, which is a waste product of phenol synthesis by the Hock method.

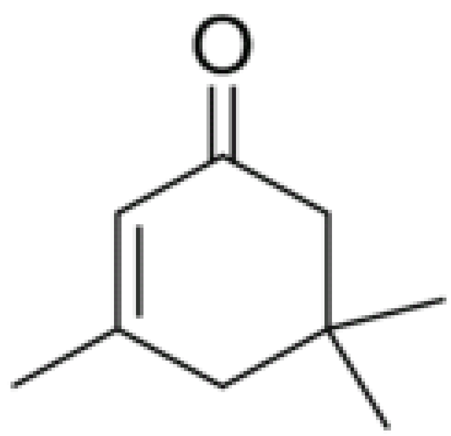

Figure (3.3.1.3): Isophorone structure ($C_9H_{14}O$)

3.3.1.3: Ethyl Cinnamate ($C_{11}H_{12}O_2$)

Ethyl Cinnamate is the ester of cinnamic acid and ethanol. It is present in the essential oil of cinnamon. Pure ethyl cinnamate has a "fruity and balsamic odor, reminiscent of cinnamon with an amber note. It found in the *Kaempferia galanga* plant.

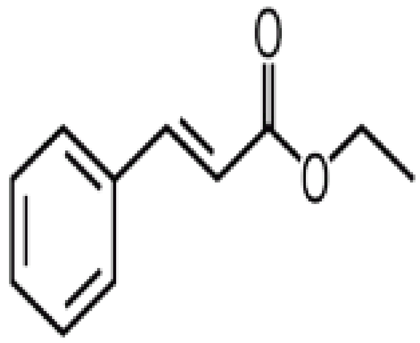

Figure (3.3.1.3): Ethyl Cinnamate structure($C_{11}H_{12}O_2$)

3.3.1.4: Mesitylene ($C_9H_{12}Me_3$)

Mesityleneis derivative of benzene with three Methyl substituents.it is component of Cola tar which is its traditional source.

Mestylene is mainly used as precursor to colorants, additive and component of some aviation gasoline blends.

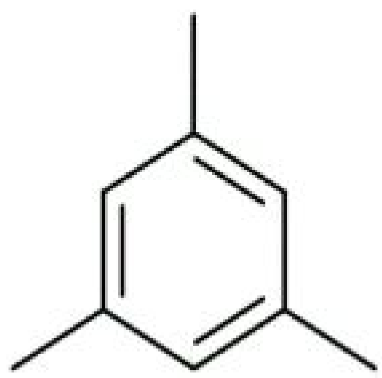

Figure (3.3.1.4): Mesitylene structure ($C_9H_{12}Me_3$)

Table 3.6: Components of *Artemisia herba alba* Essential Oil: -

ID#	Name	Ret.Time	Area	Area%
1.	Butanoic acid, 2-methyl-, ethyl ester	3.127	1361183	1.07
2.	Butanoic acid, 3-methyl-, ethyl ester	3.167	603461	0.47
3.	3-Nonen-2-one	3.971	226669	0.18
4.	3-Dodecyne	4.067	276466	0.22
5.	Butanoic acid, 2-methyl-, propyl ester	4.525	403500	0.32
6.	5-Methyl-5-octen-1-ol	4.563	1511068	1.19
7.	Camphene	4.615	325498	0.26
8.	2(5H)-Furanone, 5,5-dimethyl-	4.750	292123	0.23
9.	Benzaldehyde	4.906	341091	0.27
10.	Benzene, 1,2,3-trimethyl-	5.414	5285602	4.16
11.	1,3,3,4-Tetramethyl-2-oxabicyclo[2.2.0]hexane	5.675	443789	0.35
12.	Mesitylene	5.959	6581267	5.18

13.	Eucalyptol	6.095	240449	0.19
14.	2(3H)-Furanone, 5-ethenyldihydro-5-methyl-	6.336	1110569	0.87
15.	Bicyclo[3.1.0]hexan-2-one, 3,3,6-trimethyl-	6.438	156445	0.12
16.	Lilac alcohol D	6.498	1045136	0.82
17.	1,5-Heptadien-4-one, 3,3,6-trimethyl-	6.641	308120	0.24
18.	Spiro[2.4]heptane-5-methanol, 5-hydroxy-	6.869	1057698	0.83
19.	Bicyclo[3.1.1]hept-2-en-6-one, 2,7,7-trimethyl-	7.226	3055268	2.40
20.	cis-4,5-Epoxy-(E)-2-decenal	7.404	780334	0.61
21.	.gamma.-Terpinene	7.468	566756	0.45
22.	Bicyclo(3.3.1)non-2-ene	7.525	2359626	1.86
23.	Isophorone	7.915	17649092	13.89
24.	1-Undecene, 10-methyl-	8.121	105081	0.08
25.	1,3,3-Trimethylcyclohex-1-ene-4-carboxaldehyde,	8.175	145481	0.11
26.	Bicyclo[2.2.1]heptan-2-one, 1,7,7-trimethyl-, (1S)-	8.383	18233207	14.37
27.	2,5-Furandione, 3-methyl-4-propyl-	8.518	271911	0.21
28.	Bicyclo[3.1.0]hexan-2-one, 5-(1-methylethyl)-	8.658	198995	0.16
29.	Bicyclo[2.2.2]octane, 1,2,3,6-tetramethyl-	8.861	288498	0.23
30.	(+)-3-Carene, 2-(acetylmethyl)-	9.255	254403	0.20
31.	4-Heptenal	9.342	136541	0.11
32.	6-Methyl-5-octen-2-one	9.467	213530	0.17
33.	Bicyclo[3.1.1]hept-3-en-2-one, 4,6,6-trimethyl-	9.691	1050609	0.83
34.	Hex-3-ene-1,6-diol	9.757	819444	0.64
35.	Lilac aldehyde C	10.044	5435851	4.28
36.	Acetamide, 2-(4-benzyloxyphenoxy)-N-(2-methoxyphenyl)-	10.356	244992	0.19
37.	2-Cyclohexen-1-one, 3-methyl-6-(1-methylethyl)-	10.572	765346	0.60
38.	Bicyclo[3.1.1]hept-2-en-4-ol, 2,6,6-trimethyl-, acetate	10.633	905638	0.71
39.	R-Limonene	10.942	729743	0.57
40.	Acetic acid, 1,7,7-trimethyl-bicyclo[2.2.1]hept-2-yl ester	11.130	2772828	2.18
41.	1,6-Dimethylhepta-1,3,5-triene	11.777	4699712	3.70
42.	1,3-Cyclopentadiene, 5,5-dimethyl-1-ethyl-	11.896	6947385	5.47
43.	5-Isopropenyl-2-methylcyclopent-1-enecarboxaldehyde	12.285	668654	0.53
44.	Benzenepropanoic acid, ethyl ester	12.356	195501	0.15
45.	Cinnamaldehyde, (E)-	12.906	7761412	6.11
46.	2-Cyclopentene-1-carboxylic acid, 1,2,3-trimethyl-, ethyl ester, (.+-.)-	13.550	305395	0.24
47.	1,6-Dimethyl-9-(1-methylethylidene)-5,12-dioxatricyclo[9.1.0.0(4,6)]dodecan-8-one	13.675	100916	0.08
48.	3-Oxabicyclo[4.1.0]heptan-2-one, 4,4,7,7-tetramethyl-	13.780	303296	0.24
49.	3(2H)-Isoquinolinone, octahydro-, (4ar-trans)-	14.110	167945	0.13
50.	1,6-Octadien-4-ol, 4,7-dimethyl-	14.178	403091	0.32
51.	2-Butanone, 4-(2,3-epoxy-2,6,6-trimethylcyclohex-1-	14.219	412250	0.32

	yl)-, (+)-(1R,2R,3S)-			
52.	2-Butyl-5-methyl-3-(2-methylprop-2-enyl)cyclohexanone	14.313	1038755	0.82
53.	2-Cyclopenten-1-one, 2-pentyl-	14.448	919063	0.72
54.	2-Propenoic acid, 3-phenyl-, ethyl ester	14.542	13349256	10.51
55.	1,6,6-Trimethyl-8-oxabicyclo[3.2.1]octan-2-one	15.503	1095760	0.86
56.	Cyclohexanone, 2-acetyl-	15.710	1445584	1.14
57.	2-Pentanone, 4-(1,3,3-trimethyl-7-oxabicyclo[4.1.0]hept-2-yl)-	16.141	396484	0.31
58.	5-Ethyl-3-hepten-2-one	16.520	413658	0.33
59.	2-(1,4,4-Trimethyl-cyclohex-2-enyl)-ethanol	16.774	361178	0.28
60.	2,6-Dimethyl-9-(1-methylethyl)-1-cyclodecanone	17.392	273205	0.21
61.	7-Tetradecenal, (Z)-	17.618	760258	0.60
62.	Cyclopentaneacetic acid, 3-oxo-2-pentyl-, methyl ester	17.693	533027	0.42
63.	1,4-Benzenediol, 2-[(1,4,4a,5,6,7,8,8a-octahydro-2,5,5,8a-tetramethyl-1-naphthalenyl)methyl]-, [1R-(1.alpha.,4a.beta.,8a.alpha	17.884	1041807	0.82
64.	(7a-Isopropenyl-4,5-dimethyloctahydroinden-4-yl)methanol	17.981	297902	0.23
65.	1H-Indene, 2,3,3a,4,7,7a-hexahydro-2,2,4,4,7,7-hexamethyl-, trans-	18.375	155679	0.12
66.	(-)-Spathulenol	18.808	2947169	2.32
67.	Cyclopentadecanone, 2-hydroxy-	20.352	390864	0.31
68.	Ethylene brassylate	22.549	393888	0.31
69.	9,12-Octadecadienoic acid (Z,Z)-, methyl ester	23.208	215641	0.17
70.	9-Octadecenoic acid (Z)-, methyl ester	23.267	243723	0.19
71.	9,12,15-Octadecatrienoic acid, methyl ester, (Z,Z,Z)-	23.281	280893	0.22

Nezhadal et al; (2008) reported the essential Oil yield ranging between 0.4-1.19 w\w, and total of 61 components were identified by GC-MS in *Artemisia herba alba*plant, dominated by major compounds, camphor, a-thujone, b-thujone, chrysanthenone, chrysanthenyl acetate, or davanone.

Mounir, et al;(2015) reported, In Algerian Shih essential oil, monoterpenes were the major components, especially camphor, α-and β-thujones,1,8-cineoleand chrysanthenyl derivatives, oil contains 10 components with percentages higher than10%, In Tunisianoil oxygenated monoterpenes were found to be the major components of *Artemisia herba alba* oil extracted from aerial parts.

Haouari, et al; (2009) reported that, the oil yield varied between 0.68% v/w and 1.93% v/w, based on dried weight of the samples. One hundred components were identified, ten of them (cineole, thujones, chrysanthenone, camphor, borneol, chrysanthenyl acetate, sabinyl acetate, davana ethers and davanone) couldbeconsidered as major components, with concentrations superior to 10% of the total oil. Camphor was found at high concentrations. High levels of borneol were found in oil. The main sesquiterpenes found in the studied oil are davana ethers and davanone. Several davana ether isomers were identified.

There for, according to the previous studies and current study Camphor and terpenes are most major components of *Artemisia herba alba.*

Otherwise, the current study shows the presence of manyEsters, Phenols and Alchol with lowpercentage.

Conclusion: -

- The obtained results showed a very wide range of trace and rare earth minerals in*Artemisia herba alba*.
- Consumption oflarge amount of the aerial part of *Artemisia* may be dangerous because it contain measurable concentration ofToxic minerals (Pb,As,Sb,Sn,Cd,Hg).

- The plant may be used in small amounts as food additive for flavoring purposes.
- The chemical constituents of Shih Aqueous extract may need to be further characterized for their possible use in the medical field for enhancing the traditional uses of the plant.
- The GC-MS analysisresults may strongly support the suggestion of using Artemisia *herba alba* as anti-Malarial, anti-inflammatory and anti-viral effects at clinically acceptable concentration.
- The oil yield percentage was found to be very low and this may not encourage the oil production from economic sight of view.

Recommendations:

- Shih is a widely growing plant in so many parts of theworld. This means that the soil characteristics and climatic conditions are suitable almost throughout the different countries, and therefore a regular and organized production is possible.
- Further bioactivity research may be required for bioactive compounds in

Shih plant, that is important candidates for anti SARS-COV2 infection with increased severity of covid19 now a day.

- Due tohigh phenolic content,*Artemisia* extract may be use to exhibit antioxidant activity.
- The *Artemisia herbaalba* therapeutic potentialmay treat several health disorders without serious effects.
- The plant could be a promising source for the development of novel strategies to cure fatal maladies. Undoubtedly, because *Artemisia* genus possesses a wide range of properties.
- Shih cultivation in Sudan may reduce the export of this semi-arid growing plant.

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