International Journal of Bioorganic Chemistry
2017; 2(2): 77-82
http://www.sciencepublishinggroup.com/j/ijbc
doi: 10.11648/j.ijbc.20170202.15

Review Article

A Comparative Analysis of Some Essential Oil Plant Species, Composition, Antimicrobial Properties and Their Applicability in the Field of Drug Discovery - A Review

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To cite this article:

E. Talebi, I. Nasrollahi, M. Khosravinezhad, Shivakumar, Z. Nemati. A Comparative Analysis of Some Essential Oil Plant Species, Composition, Antimicrobial Properties and Their Applicability in the Field of Drug Discovery- A Review. *International Journal of Bioorganic Chemistry*. Vol. 2, No. 2, 2017, pp. 77-82. doi: 10.11648/j.ijbc.20170202.15

Received: February 9, 2017; **Accepted**: March 3, 2017; **Published**: March 24, 2017

Abstract: The purpose of present study was to understand the background knowledge, benefits, applicability and important medicinal properties of selected plants of *pycnocycla, oliveria decumbens* and *anvillea* that the three essential oil plants are available in different parts of the world and consists of different variability in leaves, essential oil content, *etc*. Moreover, they are seven species of plant *pycnocycla*, two species of *anvillea* and *oliveria* consists of one species alone are reviewed and their effective utilization of all the parts of the plants, *i.e.,* radiate being utilized in folk medicine to treat various infectious diseases and may contribute to the development of novel antimicrobial agents for the treatment of infections caused by these drug-resistant microorganisms (in vitro cytotoxicity and in vivo antitumor activity for both compounds) are reported by several researchers. Hence, It is important to underline that, the information survey being made in this review may generate a new avenue in the fields of pharmaceutical, *etc.* for drug discovery and the efficiency of its essential oil and applicability for several purposes like, antimicrobial and antioxidant activities, disorders, diseases controls, diseases management and beauty cosmetics, *etc* are reviewed and discussed in depth herein this review article.

Keywords: *Pycnocycla*, *Anvillea*, *Oliveria*, Essential Oil Plants, Medicinal Benefits

1. Introduction

Human being a living species on the earth needs to various chemical compounds, things, aspects, factors, *etc* for good growth and development of their body organelles. Among them environmental factors and important plant's material too necessary for various purposes like, oxygen needs for respiration, which outlets from plants, several drugs discovered were from plant made only. Apart, south Asian and African continents are huge popularized countries in the fields of pharmaceutical drug discovery especially from the various plants and needs coinciding with the rise of humans. However, way back to the history, the use of medicinal plants began by studying the civilization of ancient peoples to use herbs as medicine, poison, detergent and paint up on it. Moreover, thousands of years of human utilized plants as medicine or food for a wide range of chemical compounds in the familiar [1] and the use of herbs to treat the diseases in human life at the same time, so that in all of human history had no choice but to use herbs. The use of medicinal herbs dates back to the meaning of the declining trend in the modern world, but today in industrial societies and even in developed countries and developing countries use of medicinal plants are very impressive [2, 3]. Nevertheless, the plants that contain the active ingredient are one or some of their organs and the substances that make up less than 1% of

the dry weight in the plant, which has medicinal properties and effective against several organisms. Much glancing on it, the planting and harvesting of the plants to use the active ingredient are made from it [4]. It is noteworthy to understand that, the Iran is the one among of seven Asian countries in the World that have the most medicinal valuable herbs. It is established fact that, people in the past have used as traditional medicine as well as medicinal plants. Moreover, there are more than 130 different types of medicinal plants are available in Iran, out of all medicinal plants existing. Much emphasizing on present status of the medicinal herbs living on all over the earth, today there are about 75 thousand herbal medicines available since 5000 and marketed by the pharmaceutical industrial world. Moreover, this part of the natural history of mankind and one of the most important human food and medical supplies have been carrying out through the generations [6].

Plants (Umbelliferae), the dark and hollow stems are usually aromatic and the other is Karafsian Umbelliferae with more than 3,700 genera and 434 species are around the world [7]. Most of the Apiaceae plants, annual, biennial or perennial (often with leaves collected at the base) is although a minority, shrubs or plants are multicellular. They are variable size and alternately arranged leaves, or alternatively the upper leaves become almost contradictory. It is typically characterized by crushing the leaves and fragrant odor they emit from their members [8]. This plant is being given the Persian name Umbelliferae indenture that is meaning the dog's teeth, with 8 species, the three species are unique to the province and one species in Tehran of center and other species exist in hot and dry area. Erythronium Bashagerd is unique and not found in any part of the world [8]. Moreover, seven species in this genus are permanent with of spiny leaves, all of them are native to Iran in tropical areas such as Kermanshah, Khuzestan, Fars, Kerman, Hormozgan and Baluchistan [8]. On the other hand, another important medicinally valuable Decumbens plant belonging to the family umbrella, genus *Oliverea* and in a species name *Oliverea decumbens vent* is locally called as "Dan" or "Dank". This plant grows well in the tropical regions of Kermanshah, Khuzestan and Ilam in Iran and in addition, it also grows in South East Anatolia, Syria, Iraq. Apart, in Iran decumbens grows and scattered around the heights above the 2500 meters in Kohkiluyeh and Boyerahmad [9]. Another important plant is *Anvillea garcinii* (Asteraceae) that called black enamel and are the largest family of the vascular plants. The dark is being more than 22750 species in 1620 genera and 12 located below the dark [9]. Furthermore, the plant *Anvillea garcinii* Persian anvil with the family composition and is found in southern Iran in the form of shrub [10]. The areas of growing of this plant are Bandar Abbas (Haji Abad), sar chahan, sor khon, Siaho and the height of the plant is around 50-130 cm. Further, specific areas and semi arid desert is hot and can withstand the temperatures of 22.5 to 27.5°C [10].

2. Chemical Composition and Properties of Essential Oils

2.1. Pycnocycla Nodiflora

An elite research was carried out on the said plant (Figure 1) by extracting to find sesqui terpene compounds from plant tissues erythronium flower at different stages of growth [11]. However, few authors were utilized essential oil contents of the fruit and seeds of Pycnocycla nodflora Decne and ex Boiss growing wild in southern Iran were found to be 0.05% and 0.1% (v/w), respectively based on the fresh weight. The oils were analyzed by GC and GC-MS techniques and resulted twenty-eight and twenty-seven constituents, representing 94.7% and 89.6% of the oils were identified respectively. They have elaborated that, the major components of the P. nodiflora fruit oil were identified as E-sesquilavandulol (18.6%), spathulenol (11.9%), δ-cadinol (9.0%), t-cadinol (8.9%) and β-caryophyllene (7.9%), while the main components of that of the seeds were characterized as E-sesquilavandulol (17.2%), lavandulyl acetate (13.5%), β-caryophyllene (11.1%), bicyclogermacrene (10.5%), δ-cadinol (9.0%) and t-cadinol (6.8%) [12]. Apart, another few investigations were carried out on essential oil of Pycnocycla nodiflora Decne and ex Boiss growing wild in Iran was obtained by hydrodistallation andanalyzed by GC and GC/MS technique and seventy-two components representing 86.8% of the total oil were identified and suggested that, the main components of the oil were β-eudesmol (34.3%), hexadecanoic acid (11.5%) and spathulenol (6.9%) [13].

Figure 1. *Pycnocycla nodiflora.*

2.2. Pycnocycla Spinosa Decne

P*ycnocycla spinosa* (genus Umbelliferae) aerial parts were collected weekly during four-month growth. Hydrodistillation and gas chromatography coupled with mass spectroscopy techniques were used for essential oil and sesquiterpenes investigation. Thirty-four components were identified of which the characteristic sesquiterpenes were a -copaene, caryophyllene, a -humulene, b-ionene, d cadinene, a -calacorene, caryophyllen oxide, a -cadinol, and b-eudesmol. Moreover, the content of b-eudesmol in the essential oil varied 1.9-9.17% and a -cadinol did 0-5.59% and suggested that,

these results may indicate that essential oil of differ qualities can be obtained according to the harvest time of the plant [14]. On other hand, the oil obtained by steam distillation of the seed of *Pycnocycla spinosa* Decne & Boiss investigated by GC/MS method resulted twenty components (99–5%) were identified of which elemicin (65%), linalyl acetate (11%), β-caryophyllene (7%) and β-eudesmol (4%) were the major ones [15]. Other, hydrodistilled aerial parts oil of Pycnocycla spinosa var and spinosa were analyzed by GC and GC/MS and revealed thirty three components were identified among them, Geranyl isovalerate (14.9%), caryophyllene oxide (10.6%), α-eudesmol (9.2%) ß-citronellol (7.2%), elemicin (6.8%), r-cymene (4.7%), citronellyl acetate (4.3%), and α-cadinol (3.3%) were found as major components [16].

2.3. Pycnocycla Flabellifolia

Investigators utilized two Umbelliferae species (Family name is Apiaceae) of Iran were analyzed by GC and GC/MS method and resulted, a- Phellandrene (64.0%) and p- cymene (18.5%) were the main compo¬nents among the nineteen constituents characterized in the oil of Pycnocycia flabeUifolia representing 94.2% of the total components detected, sixteen compounds were identified in the oil of Malabaila secacide representing 80.4% of the total oil with (3 - elemene (27.1%) and hexyl 3- methyl butanoate (15.6%) as the major constituents [17].

2.4. Pycnocycla Aucheriana Decne

Pycnocycla Aucheriana Decne (Figure 2) is a vital plant volatile from the aerial parts of *Pycnocycla aucherana* and *P. musiformis* of Iranian origin was analyzed by a combination of GC and GC/MS technique and identified twenty and 23 components, approximately constituted 99.9% of the oil of P. aucherana and P. musiformis respectively. Further, among them the major constituents of P. aucherana oil were p-cymene (44.7%), α-phellandrene (25.0%), β-phellandrene (11.7%), spathulenol (5.6%) and guaiol (5.1%), while the main constituents of the oil of P. musiformis were thymol (53.5%), α-pinene (10.7%), bornyl acetate (4.2%), limonene (3.8%) and (Z)-β-ocimene (3.3%) respectively [18].

Figure 2. *Pycnocycla Aucheriana Decne.*

2.5. Pycnocycla Musiformis

The flower and leaf essential oils of Pycnocycla musiformis Hedge Lamond (Apiaceae) were separately obtained by hydrodistillation and analyzed through GC and GC/MS. Hence, Fifty-one compounds were identified in the flower oil, representing 95.6% of the total oil and the main constituents were α- pinene (24.3%), β-pinene (14.6%), (E)-nerolidol (8.6%), (Z)-β-ocimene (7.8%), myrcene (4.8%) and limonene (4.2%). In addition, the leaf oil was characterized by a higher amount of α-pinene (36.8%), (Z)-β-ocimene (9.2%), bornyl acetate (8.1%), (E)-β-ocimene (6.6%), camphene (6.2%), limonene (6.1%) and myrcene (5.8%), among the 30 components comprising 92.4% of the total oil detected, the authors clearly showed that, from both of them were bearing rich oils in monoterpenes [19].

2.6. Pycnocycla Caespitosa

Researches were carried abundantly on essential oil content in the aerial parts of the endemic species Pycnocycla caespitosa (Figure 3) growing wild in the south of Iran was found to be 0.25% based on the fresh weight and oil is extracted by said technique, observed fifty one constituents, representing 97.4% of the oil were identified. Moreover, the major components of the oil were β-eudesmol (20.3%), 2, 3, 6-trimethyl benzaldehyde (13.2%), Z-β-ocimene (6.1%), α-pinene (5.9%), spathulenol (4.6%) and ρ-cymene (4.3%) [20].

Figure 3. *Pycnocycla caespitosa.*

2.7. Pycnocycla Bashagardiana Mozaff

The essential oil content in the aerial parts of the endemic species Pycnocycla bashagardiana growing wild in the south

of Iran was found to be 1.1% based on the fresh weight. The investigators were analyzed oil by gas chromatography (GC) and GC–mass spectrometry (GC–MS). Resulted totally, forty six constituents, representing 98.1% of the oil, were identified. Out of them, the major components of the oil were myristicin (18.6%), cis-isomyristicin (15.3%), E-β-ocimene (11.6%), Z-β-ocimene (6.5%), sabinene (4.8%) and intermedeol (4.0%) [21]. Moreover, the background researches for *Anvillea* plant are as follows:

2.7.1. Anvillea Radiate

Recently, natural products have been evaluated as sources of antimicrobial agents with efficiencies against a variety of microorganisms. This study described the phytochemical screening and the antifungal activity of *Anvillea radiate* (Figure 4). On the other hand, phytochemical analysis revealed the presence of some chemical groups such as volatile oils, fatty acids, tannins, flavonoids, anthracénosides, emodols, saponins, free quinones, anthraquinones, alkaloids, sterols and triterpenes. More interesting, the antifungal activity of flavonoid extracts and cell-wall polysaccharide extracts derived from the flower and leaves of *A. radiata* were tested against plant pathogenic fungi Fusarium oxysporum f. sp. albedinis (Foa) (causing vascular wilt of date palm) by agar well diffusion method. The results indicate that flavonoid extracts had the strongest inhibitory effects on spore germination and on soil population density of Foa. Because, of its highly methylated pectins (HMP) from flowers produce the greatest inhibitory effect on mycelial growth. The sporulation was strongly inhibited using cellulose-based agar of leaves. Thus, it can be concluded that the use of A. radiata extracts could be considered as an antifungal available to develop novel types of natural fungicides and to control several plant pathogenic fungi [26]. Hence, to evaluate the possible in vitro antimicrobial activity of *Anvillea radiata* Coss & Dur organs (Asteraceae) against a panel of microorganisms and to characterize the putative compounds responsible for this activity. As usual, the method Hydroalcoholic utilized to extract and its fractions (petroleum ether, chloroform, ethyl acetate, n-butanol and water fractions) were tested against eleven microorganisms including six bacteria species, two yeasts and three filamentous fungi using disc diffusion and broth microdilution methods. Qualitative screening of the highly active extracts was done using thin layer chromatography (TLC) analysis and resulted Crude methanolic extracts and fractions of A. radiata organs showed in vitro antimicrobial activity against one or more tested pathogens. Among the tested fractions, chloroform and ethyl acetate fractions derived from methanol extract of leaves demonstrated maximum activity against Bacillus cereus (MIC: 0.156 mg/ml) followed by n-butanol fraction (0.312 mg/ml). Nevertheless, no antifungal activity was seen with any of the extracts tested. Apart, the TLC analysis revealed the presence of high levels of some secondary metabolites in the leaf active extracts of A. radiata, which have been linked to antimicrobial properties. Finally, it has been concluded that, obtained results provide justification for the use of A. radiata in folk medicine to treat various infectious diseases and may contribute to the development of novel antimicrobial agents for the treatment of infections caused by these drug-resistant microorganisms [27].

Figure 4. *Anvillea radiate.*

2.7.2. Anvillea Garcinii

It is another economically important plat, the *cis*-isomer (2) of the previously isolated parthenolid-9-one (1) was isolated from *Anvillea garcinii* (Figure 5) and the structures and relative stereo chemistries of both were determined from NMR data in combination with single-crystal X-ray analysis. Thereby, in vitro cytotoxicity and in vivo antitumor activity for both compounds are reported [28]. The antimicrobial activity of methanolic extracts from different parts of eleven indigenous wild plant species used in traditional medicines of Iran were tested against nine species of microorganisms: *Escherichia coli*, *Staphylococcus aureus*, *Staphylococcus epidermis*, *Pseudomonas aeruginosa*, *Klebsiella pneumoniae*, *Salmonella typhi*, *Bacillus subtilis*, *Aspergillus niger* and *Candida albicans*. Further, the antimicrobial efficacy was determined using the disk diffusion (0.5, 1, 2 and 4 mg/disk) and minimal inhibition concentration (MIC) method. Among the 11 tested herbs, 9 plants showed antimicrobial activity against one or more species of microorganism. Hence, the most active antimicrobial plants were Stachys obtusicrena, Anvillea garcinii, Salvia species, Otostegia persica and Teucrium persicum [29]. Background research for *Oliveria decumbens Vent* plant is as follows:

Figure 5. *Anvillea garcinii.*

2.7.3. Oliveria Decumbens

The essential oil of *Oliveria decumbens* was investigated for its components and antimicrobial activity against six bacteria and two fungal strains (Figure 6). The authors were characterized essential oil by a high amount of oxygenated monoterpene components of which thymol (47.06%) and carvacrol (23.31%) were major components. They have reported that, the oil exhibited high antimicrobial activity against all tested gram (+) and gram (−) bacterial and fungal strains [22]. Later on few other researches were also conducted by scientists and revealed composition of the essential oil of *Oliveria decumbens* vent was analyzed through standard method and among the 14 components identified in the oil, thymol (37.2%), carvacrol (22.1%), γ-terpinene (12.8%), p-cymene (11.8%) and myristicin (9.6%) were found to be the major constituents [23]. On other hand, it is distinguished fact that, *Oliveria decumbens* vent (Umbelliferae) is a shrub commonly found in the south east of Iran and its aerial part is extensively used in herbal medicine. Further, in their study, the antimicrobial activity of O. decumbens essential oil extracted from aerial parts of plant against a panel of microorganisms including gram positive, gram negative bacteria, yeast and fungi were assessed by disc diffusion method and micro broth dilution assay. The chemical constitutes of this oil was analyzed by GC and reported the main components of essential oil were thymol (26.9%), carvacrol (0.25%), p-cymene (13.3%) and g-terpinene (11%). It is very important to note down, oil exhibited strong antifungal activity against filamentous fungi and yeast with average of inhibition zone (AIZ) 34.86 and MIC£0.25ml ml^{-1}. Further, the effect of 2 ml of essential oil (IZ³27.3 mm) is larger than Amphotricin B (IZ £17) against fungi. The gram positive bacteria are more sensitive than gram-negative bacteria (21.9 Vs 18.4) and spore forming bacteria (Bacillus sp.) are resistant to essential oil and the effect of oil against Bacillus sp. had inhibitory effect (MIC>2 ml ml^{-1}). Moreover, pseudomonas aeruginosa were more resistant than others (IZ<8 mm). Thus, microorganisms differ in their resistance to O. decumbens oil, *i.e.* bacteria are more resistant than fungi and gram negative bacteria are more resistant than gram positive bacteria. These effects are more concerned to phenol components especially thymol. Therefore, further studies are required to evaluate in vivo efficacy [24]. The essential oils of *Satureja khuzestanica* (before flowering & full blooming), *Oliveria decumbens* and *Thymus daenensis* collected from Ilam province, Iran, were analyzed by GC and GC-MS and evaluated for their antioxidant activity using three methods. All plant samples were also analyzed for total phenolic contents (TPC) and the major compound of essential oils of *S. khuzestanica* at both stages was the phenolic monoterpene carvacrol (93.7 and 94.3%) with this, the major components of *T. daenensis* essential oils were carvacrol (76.8%), linalool (6.9%), and *trans*- caryophyllene (6.3%). The essential oil of *O. decumbens* was characterized as thymol (33.8%), carvacrol (32.2%), γ-terpinene (15.2%) and p-cymene (14.9%). The results obtained to evaluate the antioxidant activity and TPC showed that *Thymus daenensis*, *Satureja khuzestanica* and *Oliveria decumbens* essential oils can be considered good sources of natural compounds with significant antioxidant activity. Moreover, for *O. decumbens*, a high antioxidant activity and TPC was observed, which is mainly due to the presence of thymol and carvacrol in the essential oil properties [25].

Figure 6. *Oliveria decumbens.*

3. Conclusion

The ability to synthesize a wide variety of chemical compounds that are used to perform important biological functions, and to defend against attack from predators such as insects, fungi and herbivorous mammals is called herbal medicine. The selected three plant species are rich in various kinds of valuable essential oil contents, which are vital chemical composition needful for several purposes in folk medicine to treat various infectious diseases and may contribute to the development of novel antimicrobial agents for the treatment of infections caused by these drug-resistant microorganisms (radiate). Apart, in vitro cytotoxicity and in vivo antitumor activity for both compounds are reported by several researchers and few were utilized in the field of cosmetic and others purposes. The present review survey inferred these three species (*Pycnocycla, Oliveria and Anvillea*) availability in different parts of the world, nature of growth in detailed and importance of pharmaceutically valuable essential oil chemical compounds and having capacity to uplift the antimicrobial and antioxidant activities. Hence, the information survey made in this review may be generate a new avenue for the drug-discovery, which is somewhere needful to the society and the information surveyed on essential oil of three species and its chemical compounds are conveniently be utilized and applicability being made in the fields of medicinal ayurvedic, *etc*. These phytochemicals have beneficial effects on long-term health when consumed by humans and even animals, and can be used to effectively treat diseases. Modern medicine now tends to use the active ingredients of plants rather than the whole plants thus it is necessary to discover compounds of each part of herbal plants, separately for understanding its effect on health.

Acknowledgements

The first author wishes to express sincere thanks to the

Faculty and Chairman (Head of the Department), Department of Animal Science, Darab branch, Islamic Azad University, Darab, Fars, Iran for extending the laboratory facilities to carry out the research work.

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