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Chemical Compositions of the Essential oil of *Aerva javanica* Leaves and Stems

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Abstract

The essential oils from leaves and stems of *Aerva javanica* was extracted through dry steam distillation and the chemical composition of the oil was determined by Gas Chromatography-Mass Spectrometry (GC-MS). Total nineteen compounds were identified, representing 82.96% and 78.92% of the leaves and stems, respectively. The essential oil of *Aerva javanica* leaves was found to be rich in hentriacontane (21.48%), nonacosane (20.59%), heptacosane (19.78%), pentacosane (5.58%), octacosane (3.47%), triacontane (2.81%) and hexacosane (2.04%). Whereas the essential oil of stems was determined to be rich in nonacosane (23.26%), heptacosane (22.48%), hentriacontane (18.32%), octacosane (3.42%), triacontane (2.24%) and squalene (2.07%). Thirteen chemical constituents were common in the essential oil of both leaves and stems of *Aerva javanica*.

Keywords: *Aerva javanica*; Amaranthaceae; Essential oil; Dry steam distillation; GC-MS.

Introduction

Amaranthaceae family consists of about 169 genera and 2300 species [1], mostly abundant in tropical regions of India, Africa and America. The family contains most of the important allergic species (*Aerva lanata, Aerva Persica, Aerva javanica*) [2]. Genus *Aerva* belongs to family Amaranthaceae and represented by 20 species in Pakistan [1]. Literature survey revealed that various species of *Aerva* are used as analgesic and exhibit anti microbial, anti-inflammatory activities. *Aerva* species are used as a valuable medicine for throat pain, cough, wounds and ingestion [3].

Aerva javanica (family: Amaranthaceae) plant is a perennial herb and distributed in various parts of the world. It is a native to Africa and also occurs in some of the Asian countries. In traditional medicine, this herb is used as diabetic, diuretic and demulcent. The decoctions of the *A. javanica* are used to remove swelling and powder of this plant is applied externally to ulcers in domestic animals. The seeds are used to relieve headache. Flowers and roots of *Aerva javanica* possess medicinal properties against kidney problems and rheumatism. Paste made up of inflorescence and leaves is used externally to heal the wounds and inflammation of joints. Decoction of plant is used as a gargle for toothache. The leaves of plant are used for fodder to goats and whole plant is used as a fuel [4]. The whole *A. javanica* plant is used for the purpose of chest pain, ascaris and diarrhea with blood [5]. The presence of carbohydrates, steroids, triterpenoids and flavonoids has been reported earlier in *Aerva javanica* [6].

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Aerva javanica shows anti-microbial [1], anti-hyperglycaemic [6], cytogenetical [7], cytotoxic [8], anti-plasmodial [9] and anti-diarrhoeal [10] activities.

The present study reports the composition of the essential oil of *Aerva javanica* leaves and stems extracted by dry steam distillation for first time.

Various extraction methods are used for the determination of amount and composition of essential oils and other related compounds from aroma-active plants. Literature survey revealed that hydrodistillation is a common method for the determination of essential oil contents [11-22], but the chances of transformation processes of the compounds due to the influence of heat, steam and pH in this method, therefore it may not be a suitable method for non-volatile aroma-active compounds [23]. However, in dry steam distillation method only steam comes in contact with the biomass at atmospheric pressure. The temperature of steam can not build up or ruin the product that eliminates the possibility of decomposition of the plant constituents.

Experimental

Collection of plant material

Leaves and stems of the *Aerva javanica* plant were collected from Village Mehendri-Jo-Par (longitude: N 25˚ 34' 2'' and latitude: E 70˚ 11' 20''), District Umerkot, Sindh, Pakistan in January 2011. A voucher specimen (15174) of the plant was deposited in the herbarium of Institute of Plant Sciences, University of Sindh Jamshoro, Pakistan. The plant was identified by a Professor Dr. Muhammad Tahir Rajput of the same institution. Each part of the plant was washed thoroughly 3 times with sterile water, dried in shadow, and then finely ground to a suitable size and stored in plastic container before analysis.

Isolation of the essential oils

Air-dried leaves and stems of the plant (70 g of each part) were subjected separately to dry steam distillation [24-25] for 3 h. The oil was separated from water by using n-hexane (HPLC grade) that was dried over analytical reagent grade anhydrous Na_2SO_4 and then stored at 4 °C in sealed vials before GC-MS analysis.

Gas chromatography-mass spectrometry (GC-MS)

Agilent 6890 N GC instrument coupled with MS-5975 inert XL mass selective detector and auto sampler 7683-B injector was used for GC-MS analysis of the essential oil of *A. javanica*. The HP-5MS column with dimensions of 30 m × 0.25 mm i.d., film thickness 0.25 μm was used for the analysis. The temperature of oven was held at 80 °C for 2 min, raised to 200 °C at 5 °C/min (1 min hold) and then to 280 °C at 20 °C/min (3 min hold). 1.0 μL sample was injected, using split mode (split ratio, 1:10). Helium gas was used as a carrier gas at a flow rate of 1.5 mL/min. An electron ionization mode with ionization energy of 70 eV was used for MS detection. The injector and MS transfer line temperatures were set at 220 and 290 °C, respectively.

Identification of components

Individual components of the essential oils were identified by comparison of the mass spectra with the reference compounds in the data systems of National Institute of Standards and Technology (NIST) spectra libraries matching. Compounds were identified with a resemblance percentage above 90%. Percentage composition of oils was computed from peak areas of GC.

Results and Discussion

The dry steam distillation of the leaves and stems of *Aerva javanica* gave light yellowish oil (0.1%). The complete chemical composition of essential oil, retention time (RT) in minutes and percentages of identified compounds and are summarized in (Table 1). These obtained results are presented in their elution order on HP-5MS column. Nineteen compounds in total have been identified from both leaves and stems of *A. javanica*, shown in (Fig. 1 and Fig. 2). Sixteen compounds identified from each part, constituting over 82.96% and 78.92% of oils composition from leaves and stem, respectively.

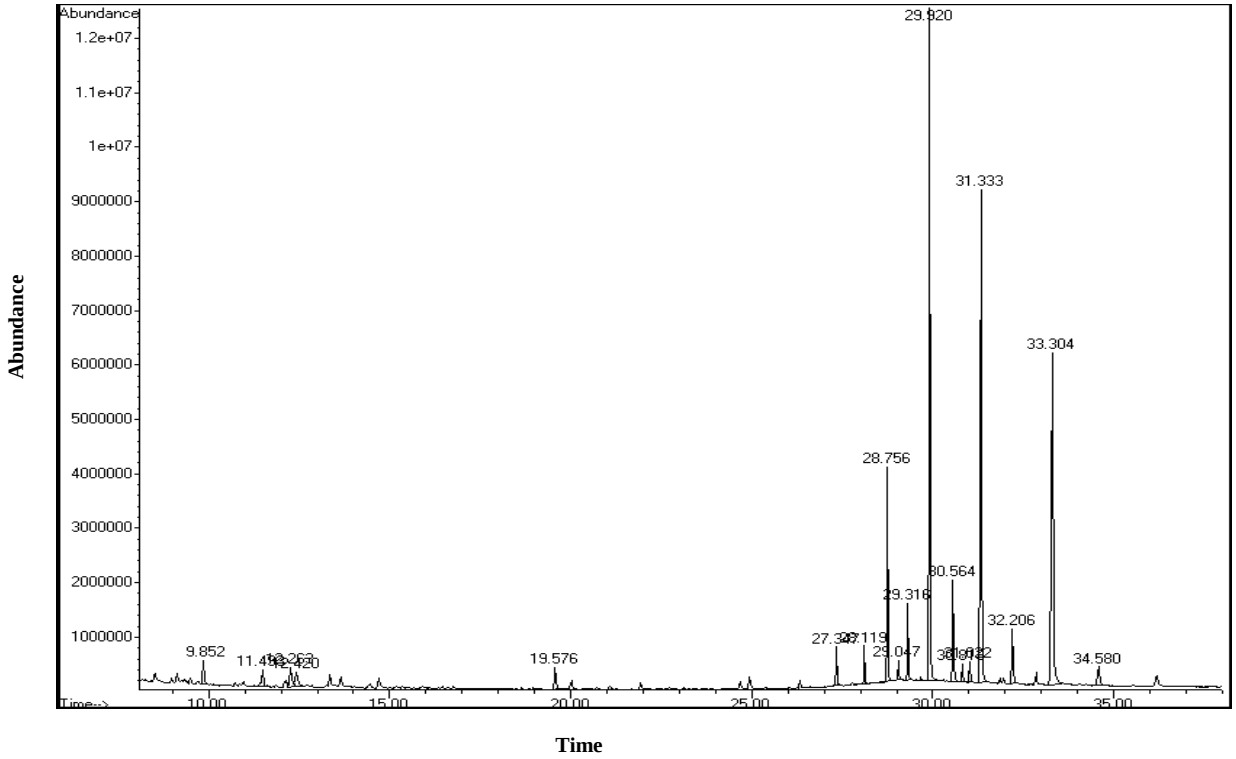

Figure 1. **GC chromatogram of *A. javanica* leaves.**

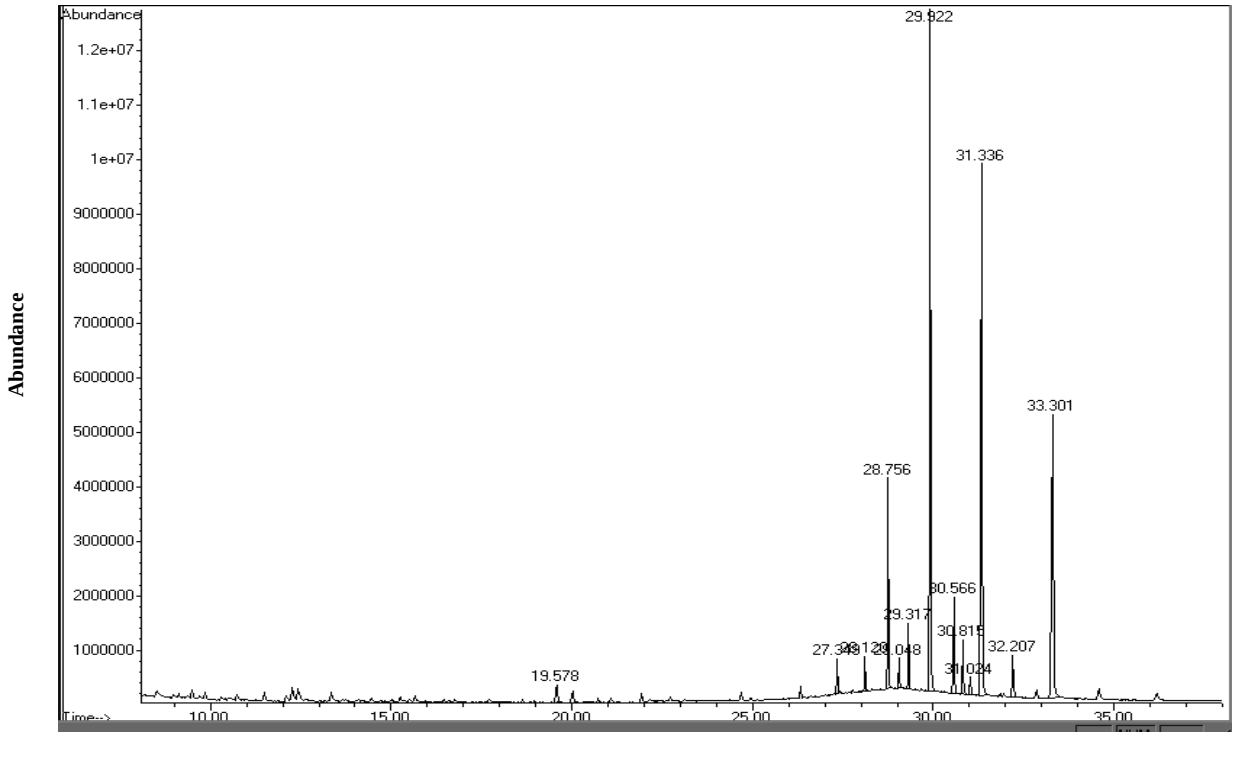

Figure 2. **GC chromatogram of *A. javanica* stems.**

Table 1. **Chemical composition of essential oils from leaves and stems of *Aerva javanica.***

Sr. No.	Compounds	% Area		RT
		Leaf	Stem	
1.	*β*-Damascenone	0.59	0.27	09.13
2.	*trans*-*β*-Ionone	1.31	0.55	11.49
3.	Megastigmatrienone	0.77	-	14.70
4.	Octadecane	-	0.17	18.65
5.	6,10,14-Trimethyl-2-pentadecanone	1.33	1.23	19.58
6.	Nonadecane	-	0.25	20.73
7.	Eicosane	-	0.18	22.73
8.	Heneicosane	0.51	-	24.68
9.	Docosane	0.30	0.42	26.33
10.	Tricosane	1.07	1.15	27.35
11.	Tetracosane	0.96	0.97	28.12
12.	Pentacosane	5.58	-	28.76
13.	Hexacosane	2.04	1.94	29.32
14.	Heptacosane	19.78	22.48	29.92
15.	Octacosane	3.47	3.42	30.57
16.	Squalene	0.37	2.07	30.82
17.	Nonacosane	20.59	23.26	31.33
18.	Triacontane	2.81	2.24	32.21
19.	Hentriacontane	21.48	18.32	33.30

The volatile fractions of *A. javanica* consisted of a complex mixture of different substances with ketones (Leaf: 1.33%, stem: 1.23%), terpenoids (Leaf: 3. 04%, stem: 2.89%), and hydrocarbons (Leaf: 78.59%, stem: 74.80%). The major constituents of the leaves oil were hentriacontane (21.48%), nonacosane (20.59%), heptacosane (19.78%), pentacosane (5.58%), octacosane (3.47%), triacontane (2.81%) and hexacosane (2.04%). The main components of the stems oil were nonacosane (23.26%), heptacosane (22.48%), hentriacontane (18.32%), octacosane (3.42%), triacontane (2.24%) and squalene (2.07%).

β-damascenone, *trans*-*β*-ionone, 6,10,14-trimethyl-2-pentadecanone, docosane, tricosane, tetracosane, hexacosane, heptacosane, octacosane, squalene, nonacosane, triacontane and hentriacontane were common chemical constituents of essential oils.

The chemical class distributions of the volatile constituents are summarized in (Table 2). The compounds were separated into three classes, which were terpenoids (oxygenated monoterpenes, triterpene hydrocarbons and terpene related compounds), ketones and hydrocarbons. The literature survey revealed that no work already has been done on the chemical composition of the essential oil of *Aerva* genus.

Table 2. **The chemical class distribution in the essential oils of *Aerva javanica*.**

Constituents	Leaves		stems	
	% Area	NC	% Area	NC
Terpenoids				
Oxygenated monoterpenes	1.31	1	0.55	1
Triterpene hydrocarbons	0.37	1	2.07	1
Terpene related compounds	1.36	2	0.27	1
Ketones	1.33	1	1.23	1
Hydrocarbons	78.59	11	74.80	12
Total	82.96	16	78.92	16

NC: Number of compounds

The major constituents were hydrocarbons in leaves 78.59% and in stems 74.80% in the oils of *A. javanica*. The compositions of the essential oils extracted from the leaves and stems were almost similar

Conclusion

The Essential oils from leaves and stem of the *Aerva javanica* were obtained by dry steam distillation method and examined by GC–MS. The results show that the essential oil of both leaves and stem can be a good source of hydrocarbons. Thirteen chemical constituents were common in the essential oil of both leaves and stems of *Aerva javanica*.

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