Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

J P P Journal of Pharmacognosy and Phytochemistry

E-ISSN: 2278-4136
P-ISSN: 2349-8196
JPP 2014; 3(4): 160-163
Received: 4-09-2014
Accepted: 03-10-2014

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Essential oil composition of *Artemisia japonica* Thunb. from Kerala

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Abstract
The genus *Artemisia* has a medicinal history reaching back over two millennia and some of its extracts and isolates are of proven efficacy against several diseases. *Artemisia japonica* Thunb. (Syn. *Artemisia parviflora* Buch. -Ham. ex D. Don) is a member of family Asteraceae. The plant is collected from Idukki district of Kerala. The leaves were shade dried and the essential oil was obtained by hydrodistillation using Clevenger type apparatus and subjected to GC-MS analysis. Fifteen compounds were identified in the oil, constituting 34.3 % of the oils. Spathulenol (12 %), Germacrene D (7.5 %), β-elemene (2.8 %), caryophyllene (2.4%) were found to be the major components of the essential oil. The oil is dominated by sesquiterpene hydrocarbons.

Keywords: *Artemisia japonica*, essential oil, spathulenol, germacrene D, β-elemene, caryophyllene.

1. Introduction
Artemisia L. is an economically important cosmopolitan genus, comprises around 500 species of small aromatic shrubs and herbs [1]. *Artemisia japonica* Thunb. (Syn. *Artemisia parviflora* Buch.-Ham. ex D. Don) is a member of the family Asteraceae (Compositae) and is distributed in India, Myanmar, Pakistan, Nepal, Bhutan, Afghanistan and Japan. It is a nonaromatic perennial herb which is reported in the southern Kerala particularly in Munnar. This plant is used in medicine and extracting essential oil, having anti-viral and anthelmintic properties [2]. The plant has been used as a traditional medicine to treat fever and eczema [3]. In traditional medicine, various parts of *Artemisia japonica* (leaves, stem, seeds and fruits) have been widely used by tribal people for its wound healing properties, treatment of skin diseases, febrifuge, depurative properties, digestive and in ethnoveterinary medicine [4]. Antimalarial activity of *A. japonica, A. maritima* and *A. nilagirica* had been studied [5].
To our knowledge, there are no reports on the essential oil composition of *Artemisia japonica*. So the components of the essential oil is analysed.

2. Materials and Methods
2.1 Plant material and isolation of essential oil
The plant material was collected from Munnar of Idukki district of Kerala and were identified and the herbarium with voucher specimen *Artemisia japonica*-SHC: 04 was maintained in the College. The leaves were shade dried, crushed and the essential oil was isolated by hydrodistillation using a Clevenger type apparatus for four hours. The essential oil isolated were obtained in glass vials and stored at 4 ^{o}C for GC-MS analysis.

2.2 Gas chromatography - Mass spectrometry (GC-MS)
GC-MS analysis was carried out by 6850 Network GC system, Agilent Technologies 5975C VLMSD with Triple Axis Detector, using helium as carrier gas with a flow rate of 1.0 ml/min on split ratio 10:1 fitted with HP5MS capillary column (nominal length 30.0 m, nominal diameter 250.00 µm and nominal film thickness 0.25 µm). The temperature was programmed from 60-250 ^{0}C, initially 60-180 ^{0}C at the rate of 2.50 ^{0}C and 180-250 ^{0}C at the rate of 5 ^{0}C. The injection temperature is 200 ^{0}C.

2.3 Identification of essential oil constituents
The constituents of essential oil were identified using spectrometric electronic NIST 98 library.

3. Results and Discussion

The essential oil yield was 0.1 % and was bright yellow in colour. Fifteen compounds were identified which constitute 34.3 % of which spathulenol has 12 % (fig.2-A), gemacrene D with 7.5 % (fig.2-B), β-elemene with 2.8 % (fig.2-C), caryophyllene with 2.4 % (fig.2-D). The essential oil is dominated by sesquiterpenes particularly sesquiterpene hydrocarbons. The essential oil composition is given in table I.

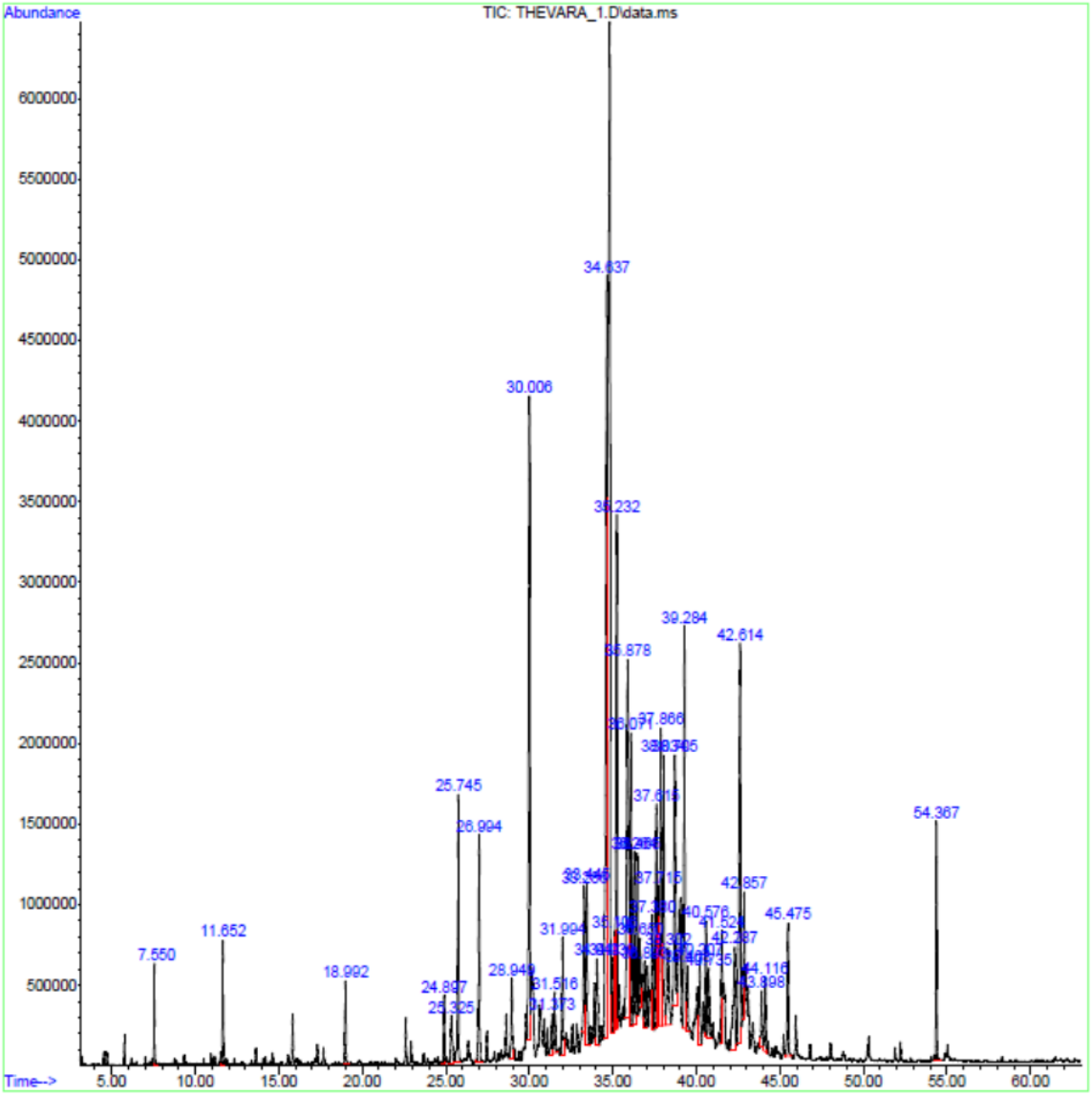
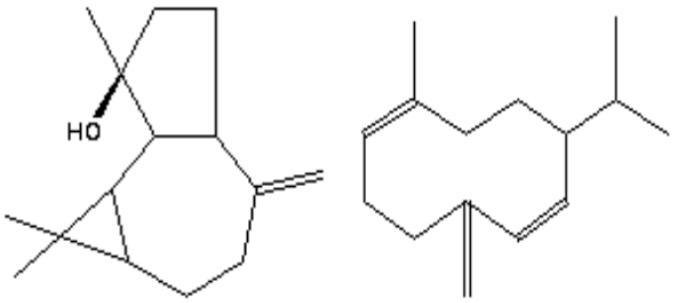
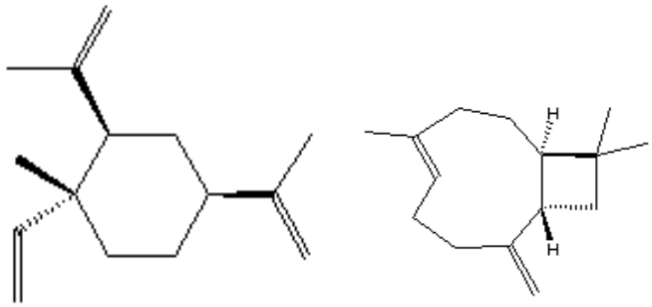


Fig 1: GCMS Chromatogram of *Artemisia japonica* leaves



A: Spathulenol B: Germacrene D



C: β-Elemene D: Caryophyllene

Fig 2: Chemical Structures of Major Compounds of Essential Oil of *Artemisia japonica*

Table 1: Chemical composition of the essential oil of *Artemisia japonica* from Kerala.

Sl. No	RT	Compound	% composition
1	11.652	Linalool	0.9
2	24.897	α-cubebene	0.6
3	25.325	β-bourbonene	0.6
4	25.745	β-elemene	2.8
5	26.994	Caryophyllene	2.4
6	28.949	Trans-β-farnesene	0.9
7	30.006	Germacrene D	7.5
8	31.373	α-farnesene	0.6
9	31.516	Naphthalene1,2,4a,5,6,8a-hexahydro-4, 7-dimethyl-1-(1-methylethyl)	0.7
10	31.994	δ-cadinene	1.3
11	34.637	Spathulenol	12
12	36.650	γ-elemene	0.6
13	36.893	Aromadendrene	0.6
14	37.380	γ-muurolene	1.4
15	40.735	6-isopropenyl-4,8a-dimethyl-1,2,3,5, 6,7,8,8a-octahydro-naphthalen-2-ol	0.8
% Identification - 34.3 Grouped Components Sesquiterpene hydrocarbon - 20.5 Monooxygenated sesquiterpene - 12.9 Oxygenated monoterpene - 0.9			

Sujatha *et al* [6]. Reported the essential oil of *Artemisia vulgaris* L. (mugwort) as slightly greenish in colour, and the yield of essential oil was 0.4 % whereas the oil of *Artemisia japonica* was bright yellow in colour and with an intense odour and the yield was 0.3 %. The intense odour may be due to the presence of oxygenated mono and sesquiterpenes. Studies on the essential oil of *Artemisia herba-alba* by Lawrence [7] & Lemberg [8] revealed the presence of oxygenated monoterpenoids such as 1,8-cineole, chrysanthenone, chrysanthenol (and its acetate), α/β-thujones and camphor as the major components, whereas in the studied essential oil of *Artemisia japonica*, these components were completely absent. Padalia *et al* [9]. analyzed and compared the essential oil composition of *Artemisia annua* growing in Uttarakhand, India, and identified 81costituents, with linalool (0.1-11.9%), β-caryophyllene (2-9.2 %), (E)-β-farnesene (1.3-8.5 %), germacrene D (0.5-7.3%) as the major components, whereas the oil of *Artemisia japonica* contained similar constituents such as linalool (0.9%), caryophyllene (2.4%), α-farnesene (0.6%) and germacrene D (7.5 %).

Joshi *et al* [10]. Investigated the essential oil composition of *Artemisia scoparia* and showed the presence of phenyl alkanes (61.2-85.5 %), γ-terpinene (11.1 %), p-cymene (4.5 %) and (E)-β-ocimene (4.4 %). Li *et al* [11]. Reported for the first time the separation and identification of volatile constituents of *Artemisia argyi* with main components as borneol and bornyl acetate, whereas, the oil of *Artemisia japonica* is devoid of these components.

β-caryophyllene, a constituent present in the essential oil of *Artemisia japonica* is a common sesquiterpene which is widely distributed in plants and possesses anti-inflammatory and anticarcinogenic activities while also playing a role in plant defence [12]. *Artemisia glabella* essential oils have pronounced anti-inflammatory properties and slight anti-proliferative and analgesic properties [13].

The chemical composition of essential oils from the *Artemisia* genus has been extensively studied in several species from around the world. Many studies have shown that *Artemisia* species display significant intra specific variations in the terpene constituents of their essential oils. In some cases, the variation in the volatile components of these plants may occur during plant ontogeny or growth at different altitudes. The quality and yield of essential oils from *Artemisia* species is influenced by the harvesting season, fertilizer and pH of soils, the choice and stage of drying conditions, the geographic location, chemotype or

subspecies, choice of plant part or genotype, or extraction method [14].

In nature, essential oils play an important role in the protection of the plants as antibacterials, antivirals, antifungals, insecticides and also against herbivores by reducing their appetite for such plants. They may also attract some insects to favour the dispersion of pollens and seeds, or repel undesirable others [15]. These activities may be due to the synergistic action of various components present in the plant. Spathulenol, the major component of essential oil of *Artemisia japonica* has various biological activities and hence the oil could be exploited for various purposes.

4. Acknowledgement

The author [1] thank Kerala State Council for Science, Technology and Environment (KSCSTE) for providing Junior Research Fellowship for the work.

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