Original Article

Volatile oils and flavones of *Stemodia viscosa* Roxb

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ABSTRACT

Stemodia viscosa Roxb., an aromatic weed used as a medicine for cold and flu and as a healing rub, is analysed for its volatile oils and flavonoids. The whole plant yielded 1.5% of a light greenish yellow volatile oil consisting of β-caryophyllene (37.1%), endo-fenchol(31.8%) and *p*-mentha-1-(7)-8-diene (19.58%)as major components. The minor constituents were α-humulene (5.88), α- cadinene (3.19%) and Δ^3- carene (1.74%). The flavones identified were scutellarein, 4'-OMe sculellarein and 7,4'- dimethoxy scutellarein. β-Caryophyllene being anti-inflammatory and scutellarein considered a potential therapeutic agent for ischemic cerebrovascular disease, the plant can be used as a source material for these valuable phytochemicals.

Key Words: *Stemodia viscosa,* volatile oil, flavones, β-Caryophyllene, endo-Fenchol, *p*-Mentha-1-(7)-8-diene, scutellarein, methoxy scutellarein

INTRODUCTION

Stemodia Benth. is a genus of about 40 species belonging to the family Scrophulariaceae occurring in tropical and subtropical regions of the world. The chemical investigation of this genus is restricted to five species from which flavonoids, labdane diterpenes, and diterpenes derivatives with a rare tetracyclic skeletal, named stemodane, were isolated. [1-3] The diterpenes of this genus are found to possess cytotoxic and antiviral properties. [4]

Stemodia viscosa Roxb., an aromatic weed found in cultivated fields of India, is of Australian origin, which is also referred to as Sticky blue rod, Pintye-pintye etc. It is an erect, aromatic, viscidly pubescent herb with quadrangular stem reaching up to 60 cm high. Leaves are 4 cm long, sessile, oblong, and amplexicaul. Flowers axillary, violet in colour and bilipped. The fragrant leaves of this herb are placed in pillows to induce a restful sleep, or crushed and mixed with fat to make a rubbing medicine to treat cold and flu symptoms. It is used as an aboriginal healing rub along with olive oil and beeswax.

The available chemical data of this plant pertain only to flavones such as diosmetin and luteolin along with their glycosides isolated from the leaves [2], and there are no previous reports on the volatile oil of this aromatic herb which is the cause of its medicinal properties. Therefore, in the present work, the plant was subjected to a chemical study on its volatile oil and other phenolics.

MATERIALS AND METHODS

The plant material was collected from the fields of Timbi near Vadodara and its voucher specimen was submitted in BARO, the Herbarium of the Maharaja Sayajirao University of Baroda, Vadodara. The whole plant was dried in the shade and subjected to steam distillation for isolation of the volatile oils. The GC-MS analysis of the oil was done at DMAPR, Anand. The instrumental conditions were the following: The

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instrument employed was Focus-PolQ GC/MS (Thermo Fisher), on a DB-5 column. The injector temperature was set at 240 °C. The injection volume was 0.5µl with a split ratio of 20. The flow rate of the carrier gas Helium was 1ml/min. Initial temperature of the column was 60°C, with a hold time of 5 minutes. The temperature was then increased to 240°C, at a rate of 3°C per minute. MS line temperature and the ion source temperature were set at 250°C and 200°C respectively. Mass range employed during scanning was 30 – 450. Individual compounds were identified as methyl esters by comparing their mass spectra with library (NIST) and literature.

The residual plant material left after steam distillation was extracted in methanol and analyzed for flavonoids by standard methods prescribed by Mabry and co-workers (1970) which included UV spectral studies involving spectral shifts with six reagents and by co-chromatography with standard compounds. Standard scutellarein was isolated from leaves of *Scoparia dulcis*. [2]

RESULTS AND DISCUSSION

The yield of the extracted volatile oil of the whole plant was 1.5%. The oil was light greenish yellow in colour with a pleasant clove like odour, which on analysis was found to contain both mono and sesquiterpenoids in almost equal amounts. The major components were β-caryophyllene (37.1%), endo-fenchol(31.8%) and *p*-mentha-1-(7)-8-diene (19.58%). The minor constituents were α- humulene (5.88%), α- cadinene (3.19%) and Δ^3- carene (1.74%).

The methanolic plant extract on hydrolysis yielded three flavone aglycones. They were visibly yellow and brown in UV indicating the 6-hydroxylation. On separation of the flavones using paper chromatography in 30% acetic acid, the first compound having lowest R_f gave a UV spectrum exhibiting λmax. in MeOH 287, 339. The bathochromic shifts with NaoMe and NaOAc indicated that both 7- and 4' positions are with free –OH groups. On co-chromatography with standard compound it was found to be scutellarein. The second compound having a slightly higher R_f gave a UV spectrum having λmax. in MeOH 288, 336. NaOMe spectrum gave a bathochromic spectrum of low intensity in Band I, indicating substitution at 4'-position. On co-chromatography with 4'OMe scutellarein the identity of this compound was confirmed. The third compound separated exhibited λmax. in MeOH 287, 335; and with NaOMe gave a bathochromic shift of low intensity in band I indicating substitution at 4'-position.The absence of any bathochromic shift with NaOAc in band II proved the methylation at C_7. Therefore this compound was identified as 7,4' dimethoxy scutellarein.

The present study is of great significance because it unearthed the fact that *Stemodia viscosa*, a insignificant common weed, is a source of valuable phytochemicals. Both the terpenoid and flavonoid components are found to be of commercial and pharmacological importance. The major component of volatile oil, β-caryophyllene, is a FDA approved food additive. It is found to be a dietary cannabinoid. In a significant study, β-caryophyllene is shown to selectively bind to the cannabinoid receptor type-2 (CB_2) to exert significant cannabinomimetic anti-inflammatory effects in

mice. [5] It is considered as an alternative to medical marijuana, because it offers the same anti-inflammatory effects without the mental and neurological side-effects. It is also found to be active against bowel inflammation and rheumatoid arthritis. Duke's database describes this compound as aldose-reductase-inhibitor, analgesic, antispasmodic, antistaphylococcic; antistreptococcic , antitumor and antiulcer. The second component of the volatile oil, endo-fenchol (an isomer of borneol) is used extensively in perfumery. *p*-Mentha-1-(7)-8-diene (pseudolimonene) is a flavoring agent, pesticide and a valuable solvent.

Scutellarein, the 6-hydroxy flavone identified from this plant, also is found to possess a number of therapeutic features. It inhibits hypoxia and moderately high glucose-induced proliferation and vascular endothelial growth factor (VEGF) expression in human retinal endothelial cells. [6] It is found to offer better protective effect on free-radical induced cytotoxicity in PC_{12} cells and therefore considered a potential therapeutic agent for ischemic cerebrovascular disease. [7] This flavone is recently found out to be a novel chemical inhibitor of Severe Acute Respiratory Syndrome (SARS) corona virus. [8]

Stemodane diterpenes consisting of rare tetracyclic skeletal structures are characteristic compounds of the genus *Stemodia*. [9] The study of these compounds with likely potential of cytotoxic and antiviral activities is remaining, following which, the full medicinal potential of *Stemodia viscosa* will be revealed.

CONCLUSION

Stemodia viscosa Roxb., an aromatic weed used as an aboriginal healing rub is studied for its volatile oil and flavonoids. The plant yielded 1.5% of a volatile oil consisting of β-caryophyllene (37.1%), endo-fenchol(31.8%) and *p*-mentha-1-(7)-8-diene (19.58%) as major components and the minor constituents were α- humulene (5.88), α- cadinene (3.19%) and Δ^3-carene (1.74%). Scutellarein and its 4'-methoxy as well as 7, 4'-dimethoxy derivatives were the flavones located. β-Caryophyllene being anti-inflammatory and scutellarein considered a potential therapeutic agent for ischemic cerebrovascular disease, the plant can be used as a source material for these valuable phytochemicals.

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