SHORT COMMUNICATION

Composition and in vitro cytotoxic activities of essential oil of Hedychium spicatum from different geographical regions of western Himalaya by principal components analysis

Tripti Mishra\textsuperscript{a}, Mahesh Pal\textsuperscript{a}\textsuperscript{b}, Sanjeev Meena\textsuperscript{b}, Dipak Datta\textsuperscript{b}, Prateek Dixit\textsuperscript{a}, Anil Kumar\textsuperscript{a}, Baleshwar Meena\textsuperscript{c}, T.S. Rana\textsuperscript{c} and D.K. Upreti\textsuperscript{c}

\textsuperscript{a}Phytochemistry Division, CSIR-National Botanical Research Institute, Lucknow 226 001, India; \textsuperscript{b}Biochemistry Division, CSIR-Central Drug Research Institute, Janki Puram Extension, Sitapur Road, Lucknow 226031, India; \textsuperscript{c}Plant Diversity, Systematics and Herbarium Division, CSIR-National Botanical Research Institute, Lucknow 226001, India

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The rhizome of Hedychium spicatum has been widely used in traditional medicines. The present study deals with the evaluation of the cytotoxic potential of rhizome essential oils from four different regions of the Western Himalaya (India) along with comparative correlation analysis to characterise the bioactive cytotoxic component. The essential oils were coded as MHS-1, MHS-2, MHS-3 and MHS-4, and characterised using GC-FID and GC–MS. The main volatile compounds identified were 1,8-cineol, eudesmol, cubenol, spathulenol and \( \alpha \)-cadinol. In vitro cytotoxic activities were assessed against human cancer cell lines such as, the lung (A549), colon (DLD-1, SW 620), breast (MCF-7, MDA-MB-231), head and neck (FaDu), and cervix (HeLa). MHS-4 is significantly active in comparison to other samples against all cancer cell lines. Sample MHS-4 has major proportion of monoterpene alcohol mainly 1,8-cineol. Principal components analysis was performed for the experimental results and all four samples were clustered according to their percentage inhibition at different doses.

Keywords: H. spicatum; rhizome essential oil; cytotoxic activity; principal components analysis

1. Introduction

The genus Hedychium consists of more than 50 species. Hedychium spicatum is a leafy plant, up to 2 m tall, having strong aromatic horizontal rhizomes. It is commonly known as ‘spiked ginger lily’ and ‘Kapoorkachari’ (Indian trade name). The plant grows wild in the Himalayan regions.
of India and Nepal at altitudes of 1800–2800 m (Kirtikar & Basu 1975; Polunin & Stainton, 1984). Their rootstocks have been widely used in traditional medicines for the treatment of skin diseases, liver complaints, asthma, and as analgesic and anti-inflammatory. The essential oil of rhizome also exhibits anthelmintic, antimicrobial and antioxidant activities (Dixit & Varma 1975; Joshi et al. 2008). Previously, a variety of terpenoids (monoterpenoids, sesquiterpenoids and diterpenoids) have been reported from *H. spicatum* (Sharma et al. 1976; Chopra et al. 1980; Sharma and Tandon 1983; Joshi et al. 2008; Reddy et al. 2009). Considering the commercial aspects, we report in the present communication the comparative terpenoid composition and simultaneous variations of cytotoxic activity of the rhizomes essential oils of *H. spicatum* collected from four different regions of the western Himalaya, India.

2. Results and discussion

2.1. Chemical composition of essential oil

The essential oil yield found in all four *H. spicatum* fresh rhizome samples (MHS-1, MHS-2, MHS-3 and MHS-4) was 0.53%, 0.24%, 0.29% and 0.38%, respectively. These essential oil samples were analyzed using GC and GC–MS. A total of 29 chemical constituents representing 84.96–91.33% of the oil have been identified (Table S1). The essential oil from all four rhizomes of *H. spicatum* was marked by the presence of sesquiterpene alcohol, monoterpene alcohol and sesquiterpene hydrocarbons. The main volatile chemical constituents identified were 1,8-cineol, hedycaryol, β-eudesmol, τ-eudesmol, cubenol and α-cadinol. The essential oil samples obtained from the rhizome of *H. spicatum* have uniform qualitative composition, whereas they differ to a considerable level, leading to variations in the distribution pattern of components.

2.2. Cytotoxic activity

Cytotoxic activity of essential oil samples of *H. spicatum* rhizomes (MHS-1, MHS-2, MHS-3 and MHS-4) were carried out and the samples were found to be active against various human cancer cell lines such as the lung (A549), colon (DLD-1, SW 620), head and neck (FaDu), cervical (HeLa) and breast (MCF-7, MDA-MB-231) with IC$_{50}$ values ranging from 26.77 to 94.33 μg/mL (Figure 1). The percentage inhibition at different drug concentrations (100, 50 and

![Figure 1. IC$_{50}$ (μg/mL) values of all oil samples for seven cancer cell lines.](image-url)
25 μg/mL) of all four essential oil samples against all cancer cell lines along with the percentage inhibition of positive control (doxorubicin) at 10 μM concentration is described (Figures S1–S6). The present study revealed that among the four samples, MHS-4 is significantly active against all the cancer cell lines whereas MHS-3 showed significant cytotoxic activity for breast (MDA-MB-231), cervical and colon cancer cell lines at all the doses in comparison to other three samples.

2.3. Statistical analysis

Principal components analysis (PCA) was performed for all experimental results (Figure 2). All four geographically different samples were clustered together according to their percentage inhibition at different doses. This showed 100 μg/mL affects more all cancer cell lines in comparison to 50 and 25 μg/mL doses and clustered in different groups. Sample MHS-2 at 50 μg/mL dose deviates towards 25 μg/mL whereas MHS-4 at 25 μg/mL dose deviates towards 50 μg/mL dose, hence MSH-2 showed the least and MHS-4 showed the most significant cytotoxic activity.

3. Conclusion

It was believed that the cytotoxic activity of *H. spicatum* was due to the presence of sesquiterpenes (Suresh et al. 2013), but, the present study revealed that the sesquiterpenes are not solely responsible for the activity because sample MHS-2 has a major proportion of sesquiterpenes, but it is the least active against all cell lines. Moreover sample MHS-4 (Almora, Binsar Uttarakhand) has a major amount of monoterpen alcohol along with sesquiterpenes comparatively in a significant amount. Thus, there may be a synergistic effect of sesquiterpenes and monoterpen alcohol for cytotoxic potency of the oil. To the best of our knowledge this is the first report regarding an interesting cytotoxic activity of the essential oils of *H. spicatum* rhizomes from four different geographical regions. Furthermore, essential oil obtained from the sample MHS-4 can be selected to isolate the potent cytotoxic molecules.

**Supplementary material**

Experimental details relating to this article are available online alongside Tables S1 and S2. http://dx.doi.org/10.1080/14786419.2015.1049176.
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