Evaluation of chemical composition in essential oils from *Schefflera octophylla* L. Hai Duong province in Vietnam

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**Abstract.** *Schefflera octophylla* L is a traditional medicine that exhibits a wide range of biological activities. However, the phytochemical content of *S. octophylla* L. essential oil is limitedly known. In the present study, *S. octophylla* L. grown in Hai Duong province (Vietnam) was extracted for essential oil by using hydrodistillation method. The resulted *S. octophylla* essential oil was further analyzed for its composition of volatile components by GC-MS analysis. Results have shown that the extraction process yielded 0.162 wt% of *S. octophylla* essential oil. In addition, the content of volatile substances in the obtained essential oil accounted for 97.07%, with main constituents known to have significant medicinal value such as myrcene (9.0%), elemene <cis-b-> (6.67%), caryophylene <E-> (= caryophylene <b->) (24.91%), selinene <a-> (6.30%) and selinene <b-> (7.29%). These findings provide a helpful insight to *S. octophylla* L phytochemical profiles for further studies on the plant applications in the fields of pharmaceuticals, cosmetics, agriculture and therapeutic uses.

1. Introduction

In recent years, people tend to prefer food products, cosmetics and pharmaceuticals that come from natural and non-toxic origin can reduce the chemicals intake and improve consumers’ health [1-5]. The plants essential oils (EOs) have high applications in many production areas export and life have been interested in research, exploitation, and processing by scientists to improve their use value [6-10]. The chemical content of essential oils includes terpenoids, alcohols, ketone, aldehyde, ester and acid [11-13]. Furthermore, the key constituents which are able to form a unique aroma for essential oils. However, the phytochemical content of *S. octophylla* L. essential oil is limitedly known.

Gas chromatography-mass spectrometry (GC-MS) is a common method used to assess the chemical compositions of EOs of *S. octophylla* from different geographical areas [14, 15]. Such difference has given rise to various phytochemical content of the essential oil, yet β-caryophyllene, humulene, myrcene,
cubebene, pinene, caryophyllene oxide and elemene are mostly found [16]. Previous research on Schefflera plants have identified the presence of triterpenes, triterpenoid glycosides and saponins [17, 18]. While the need for information on the components of *S. octophylla* EOs for food flavoring and cosmetics is increasingly required, studies to identify and analyze the aroma-forming components of *S. octophylla* EOs are limited. In the present study, the EOs from *S. octophylla* leaves was extracted by hydrodistillation, and screened for the EOs composition by using GC-MS analysis.

2. Materials and methods

2.1. Plant materials and chemicals

Fresh and healthy *S. octophylla* was collected under dry conditions from Pha Lai - Chi Linh - Hai Duong (21° 7' 14" N 106° 19' 20" E) in October 2011. The chemicals used included distilled water and anhydrous sodium sulfate, all of which were of analytical grade.

2.2. Extraction of the EOs of *S. octophylla* L.

Hydrodistillation of *S. octophylla* essential oils using a Clevenger-type device. The distillation process is carried out by boiling 1850 g of plant material. The extraction time was for about 3 hours. The resulting EOs was dehydrated using anhydrous sodium sulfate and then stored at below 4 °C in the dark before analysis. The experiment was performed in triplicates. Productivity is calculated by the following Equation (1):

\[
\text{Yield of essential oil (%) = } \frac{\text{Weight of essential oil obtained (g)}}{\text{Weight of raw materials used (g)}} \times 100\%
\]

2.3. GC-MS analysis

GC-MS analysis of EOs was conducted using an Agilent Technologies HP7890A GC equipped with an Agilent Technologies HP5975C Mass Spectrum Detector (MSD) and a DB-XLB column (60 m x 0.25 mm, film thickness 0.25 μm, Agilent Technologies). The following conditions were applied to the process: 9.3 psi of head column pressure; 1 mL/min of constant flow rate; 30 of rate of division and 250 °C of injector temperature. Thermal program was initiated at 50 °C maintained for 2 min, and then increased by 2 °C/min to 80 °C. The temperature was then elevated to 150 °C, to 200 °C and to 300 °C at the rate of 5 °C/min, 10 °C/min and 20 °C/min respectively. When reaching 300 °C, the temperature was maintained for 5 min. Compounds determination was by comparing retention time with published mass spectra (Web NIST, GMD) or Wiley library.

3. Results and discussion

The yield of *S. octophylla* essential oils obtained from hydrodistillation was 0.162 wt%. This result is comparable to the species grown in Shatin (Hongkong) with 0.16% of yield [19]. The obtained *S. octophylla* essential oil was transparent, light yellow and strong scent, which is similar to the market products. As shown in Table 1, there are 37 accounted for 97.07% of *S. octophylla* essential oil content. The components that are present in a high content include myrcene (9.0%), elemene <cis-b-> (6.67%), caryophylene <E-> (= caryophylene <b->) (24.91%), selinene <b-> (6.30%) and selinene <b-> (7.29%). The EOs contains predominantly monoterpene and sesquiterpenes, e.g. myrcene, pinene, phellandrene, germacrene, limonene and caryophyllene. Terpenes of various plants' essential oil have been reported to exhibit substantial antimicrobial activity [20-22]. According to Li et al. (2009) *S. octophylla* essential oil consisted of 27 compounds that comprise 80.9% of essential oils [19]. With main ingredients such as β-pinene (22.24%), β-caryophyllene (5.61%), limonene (3.61%), β-myrcene (3.01%), dodecanal (4.02%), germacrene D (3.56%), Tanaka and Kitajiama (1991) extracted from *S. octophylla* leaves of Japan two triterpenoid glucozit were O-α L.rhamnopyranosyl and 3-epi-betulinic acid and 3-O-β-D-glucopyranosiz [23]. Adam et al. (1991) extracted from the dry part *S. octophylla* bark obtained a new triterpene glucozit sunfat. From the spectral data, the structure of the new component is defined as 3-epi-betulinic acid, 3-O-
Sufat 28-O [-alpha - L - richyl rhamnory (1-4-O-beta-D-gluco pyranozyl (1-6)] --D-glucopyranozid [22]. Differences in EOs chemical composition is correlated with the climatic conditions, growth factors as well as the genetic variation [14; 15].

Table 1. Chemical composition S. octophylla EOs by GC-MS.

| No. | Peak | R.T. | Hit % | Chemical name       | Integral   | %   |
|-----|------|------|-------|---------------------|------------|-----|
| 1   | 5.50 | 930  | 77    | Pinene<a->           | 1293957    | 0.24|
| 2   | 6.47 | 970  | 77    | Sabinene            | 1298315    | 0.25|
| 3   | 6.57 | 974  | 86    | Pinene <b->         | 1024790    | 0.20|
| 4   | 6.92 | 988  | 94    | Myrcene             | 47770531   | 9.00|
| 5   | 7.87 | 1022 | 75    | Cymene <o->         | 606260     | 0.11|
| 6   | 7.99 | 1026 | 61    | Phellandrene <b->   | 750482     | 0.14|
| 7   | 10.19| 1099 | 88    | Linalool            | 2010053    | 0.38|
| 8   | 12.71| 1176 | 81    | Terpinen-4-ol       | 1348051    | 0.25|
| 9   | 13.18| 1190 | 60    | Terpineol <a->      | 618798     | 0.11|
| 10  | 18.34| 1347 | 89    | Cymene <o->         | 7357265    | 1.38|
| 11  | 19.19| 1374 | 98    | Copaene <a->        | 7712921    | 1.44|
| 12  | 19.66| 1388 | 87    | Cymene <o->         | 898418     | 1.26|
| 13  | 19.74| 1391 | 88    | Elemene <cis-b->    | 29611686   | 6.67|
| 14  | 20.64| 1420 | 82    | Caryophylene <E-> (=Caryophylene <b->) | 13273672 | 24.91|
| 15  | 21.18| 1437 | 45    | Aromadendrene       | 731649     | 0.14|
| 16  | 21.66| 1453 | 99    | Humulene <a->       | 40157917   | 7.65|
| 17  | 21.85| 1459 | 100   | Aromadendrene <allo-> | 779119 | 0.20|
| 18  | 22.31| 1474 | 100   | Chamigrene <b->     | 3039173    | 0.62|
| 19  | 22.48| 1480 | 88    | Germacrene D        | 1393428    | 0.28|
| 20  | 22.67| 1485 | 59    | Selinene <b->       | 32651333   | 6.30|
| 21  | 22.93| 1494 | 84    | Selinene <a->       | 37641725   | 7.29|
| 22  | 23.07| 1498 | 56    | Muurolene <a->      | 1292626    | 0.36|
| 23  | 23.22| 1504 | 54    | Germacrene A        | 3760916    | 0.87|
| 24  | 23.56| 1515 | 87    | Cadinene <g->       | 2748764    | 0.57|
| 25  | 23.76| 1522 | 45    | Cadinene <d->       | 10066195   | 1.88|
| 26  | 24.02| 1531 | 95    | Cadina-1,4-diene <trans-> | 1159293 | 0.22|
| 27  | 24.63| 1552 | 0     | unknown (79, 220, RI 1552) | 2727692 | 0.51|
| 28  | 25.41| 1578 | 69    | Spathulenol         | 10315419   | 2.01|
| 29  | 25.55| 1583 | 81    | Caryophyllene oxide | 28661352   | 5.07|
| 30  | 26.12| 1602 | 60    | Oplopenone <b->     | 1896287    | 0.39|
| 31  | 26.30| 1609 | 80    | Humulene Epoxide II | 5709615   | 1.14|
| 32  | 26.83| 1628 | 29    | Cubenol <1-epi>     | 4327217    | 0.88|
| 33  | 27.07| 1636 | 60    | Caryophylla-3(15),7(14)-dien-6-ol | 3238284 | 0.70|
| 34  | 27.23| 1642 | 48    | Cadinol <epi-a-> (=Tau-Cadinol) | 4110671 | 0.89|
| 35  | 27.60| 1655 | 0     | unknown (81, 222, RI 1655) | 11520720 | 2.16|
| 36  | 28.38| 1683 | 69    | Bisabolol <epi-a->  | 917555     | 0.17|
| 37  | 37.33| 2037 | 100   | Falcarinol <Z-> (=Carotatoxin) | 44750383 | 8.43|

Total   97.07

Monoterpenes and sesquiterpenes (Figure 1) are volatile compounds using as fragrance chemicals because of their pleasant odours. β-caryophyllene is a sesquiterpene widely distributed in EOs of various plants and is the main ingredient that accounts for the highest concentration in S. octophylla EOs. Several biological activities are attributed to β-caryophyllene, including anti-inflammatory, antibiotic, antioxidant. The scent of β-caryophyllene is defined as woody and spicy, and β-caryophyllene was widely used as a chemical fragrance [24, 25]. Legault and Pichette have shown that β-caryophyllene may increase α-humulene anticancer activity and α-humulene rises production of reactive oxygen species [26]. Based on
the relative concentration of the main ingredients in *S. octopus* essential oil, different chemical types have different biological activities, on antibacterial, antifungal, and anti-cancer abilities.

![Diagram of major components of *S. octophylla* essential oil](image)

**Figure 1.** Major components of *S. octophylla* essential oil

### 4. Conclusion

In this study, *S. octophylla* EOs extraction was performed using hydrodistillation and analyzed for phytochemical content using GC-MS analysis. Results have shown that the essential oil yield obtained was 0.162%. By using GC-MS, the main component of EOs was identified as myrcene, elemene <cis-b->, pinene, caryophylene <E-> (= Caryophylene <b->), selinene <a-> and selinene <b->. The percentage of the main ingredients in essential oils is affected by seasonal changes, species, climate and extraction techniques.

### Acknowledgment

This study was supported by grants from Nguyen Tat Thanh University, Ho Chi Minh City, Viet Nam.

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