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SHORT COMMUNICATION

Essential oils Constituents of the leaves of *Amomum gagnepainii* and *Amomum repoense*

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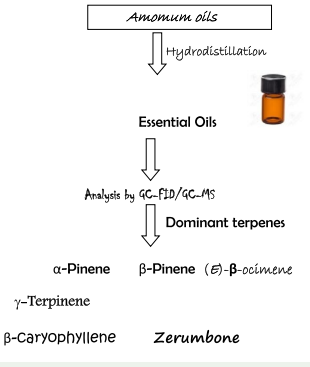
ABSTRACT

The chemical constituents identified in the essential oils hydrodistilled from the leaves of *Amomum gagnepainii* T.L.Wu, K.Larsen and Turland and *Amomum repoense* Pierre ex Gagnep (Zingiberaceae) of Vietnam origin are reported. The chemical analyses were performed by means of gas chromatography–flame ionisation detector (GC-FID) and gas chromatography coupled with mass spectrometry (GC-MS). The main compounds of *A. gagnepainii* were farnesyl acetate (18.5%), zerumbone (16.4%) and β-caryophyllene (10.5%). On the other hand, *Amomum repoense* comprised of monoterpenes dominated by β-pinene (33.5%), (*E*)-β-ocimene (9.6%), γ-terpinene (9.1%) and α-pinene (8.4%). This is the first report on the essential oils of *A. gagnepainii* and *A. repoense* grown in Vietnam or elsewhere.



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Amomum gagnepainii; *Amomum repoense*; essential oil; monoterpenes; sesquiterpenes

1. Introduction

In this paper, the chemical constituents of essentials oils hydrodistilled from two *Amomum* plants grown in Vietnam were reported. *Amomum* Roxb. is one of the largest genera in the ginger family (Zingiberaceae) with about 150–180 species (Nguyen 2000). *Amomum*

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gagnepainii T.L.Wu, K.Larsen and Turland is a perennial plant producing a clump of leaves up to 25 cm tall from a tuberous root stock (Nguyen 2000). The plant is harvested from the wild for its fruits, which are used as flavouring agents (Nguyen 2000). *Amomum repoense* Pierre ex Gagnep. is an erect herb about 1.5–3.5 m high. It has multiple medicinal uses from appetite stimulant to pain reliever and diarrhoea (Nguyen 2000).

The aim of the present study was to examine the constituents of essential oils from the leaves of *A. gagnepainii* and *A. repoense* grown in Vietnam for the first time. This is in reference to our continued interest in the analysis of the chemical constituents of essential oils from *Amomum* plants and other poorly studied species of Vietnamese flora (Huong et al. 2014, 2015; Chau et al. 2015; Dai et al. 2016).

2. Results and discussion

The yield of essential oils was 0.20% (v/w, *A. gagnepainii*) and 0.25% (v/w, *A. repoense*), calculated on a dry weight basis. The identity and percentages of the chemical constituents present in the oil samples and their retention indices on HP-5MS column could be seen in Table 1.

Sesquiterpene hydrocarbons (36.4%) and oxygenated sesquiterpenes (52.1%) represented the main classes of compounds present in *A. gagnepainii*. Monoterpenes are less common. The sesquiterpene compounds occurring in higher amount were farnesyl acetate (18.5%), zerumbone (16.4%) and β-caryophyllene (10.5%). Significant quantity of benzyl benzoate (6.5%), δ-cadinene (4.5%), valencene (3.9%), α-humulene (3.2) and bornyl acetate (3.0%) was also identified in the oil. On the other hand, monoterpene hydrocarbons (75.7%) represent the most abundant class of compounds present in *A. repoense* oil. The oil also features sizeable proportions of oxygenated monoterpenes (7.4%), diterpenes (5.0%) and non-terpenes (5.6%). The monoterpene, β-Pinene (33.5%) was the only compound occurring in highest amount. There are significant amounts of (*E*)-β-ocimene (9.6%), γ-terpinene (9.1%) and α-pinene (8.4%).

Although several reports are available on the chemical composition and biological activities of *Amomum* plants, there is no such information in the literature with respect to *A. gagnepainii* and *A. repoense*. For example, limonene (20.8%), valencene (18.0%) and α-phellandrene (8.7%) were the main compounds of the essential oil of *A. aculeatum* (Huong et al.

Table 1. Major constituents of *A. gagnepainii* and *A. repoense*.

			Percentage composition	
Compounds[a]	RI[b]	RI[c]	*A. gag*	*A. rep*
α-Pinene	939	932	1.0	8.4
β-Pinene	980	978	0.8	33.5
(*E*)-β-Ocimene	1052	1044	0.1	9.6
β-Caryophyllene	1419	1417	10.5	0.4
γ-Terpinene	1061	1056	0.2	9.1
Zerumbone	1732	1732	16.4	–
Farnesyl acetate	1846	1840	18.5	–

Notes: –not identified.
A. gag, *A. gagnepainii.*
A. rep, *A. repoense.*
[a]Elution order on HP-5MS column.
[b]Retention indices on HP-5MS column.
[c]Literature retention indices (National Institute of Science and Technology [NIST], 2011).

2014). The major compounds identified in the oils of *A. maximum* (Huong et al. 2015) were β-pinene (20.4–40.8%), α-pinene (6.8–15.0%), β-elemene (2.5–12.8%) and β-caryophyllene (2.3–10.3%). Eucalyptol (23.87%) and limonene (22.77%) were the major components of *A. tsakoo* (Wang et al. 2014). The leaf oil of *A. longiligulare* (Chau et al. 2015) comprised mainly of β-caryophyllene (26.6%), α-pinene (15.6%), humulene epoxide II (14.8%) and α-humulene (12.5%). The major compounds in the stem were β-caryophyllene (37.4%), α-humulene (16.5%) and hexahydrofarnesyl acetone (10.0%). However, camphene (15.7%), hexadecanoic acid (10.0%), octadecanoic acid (8.6%) and bornyl acetate (7.8%) were the main constituents of the root oil (Chau et al. 2015).

It is well known that *Amomum* oils' composition exhibited considerable qualitative and quantitative variations both between and within species. The leaf oil of *A. villosum* (Dai et al. 2016) comprised mainly of β-pinene (34.7%-56.6%) and α-pinene (11.6%-22.1%) while the main compounds in the essential oil of dry fruits of *A. villosum* (Song et al. 2004) were camphor (36.9%), camphene (13.9%), limonene (13.4%) and bornyl acetate (11.1%). The main chemical constituents of the seed essential oil of *A. villosum* (Lian et al. 1987) were identified as bornyl acetate (40.60%), borneol (14.30%), d-camphor (17.15%) and 1-camphor (10.75%). Camphor (23.2 and 34.1%, respectively) and bornyl acetate (14.5 and 17.0%), respectively, were the main constituents of the leaves and fruits of *A. villosum* (de Boer et al. 2014). Moreover, β-phellandrene (11.6%) was present in the root oil. Also, α-pinene (24.1–54.7%) and β-pinene (9.2–25.9%) were identified in the oils of *A. muricarpum* along with limonene (7.4%) and δ-3-carene (9.4%) which are present in the leaves and stem oils, respectively. However, while β-phellandrene (8.3%) could be seen prominent in the root oil, the fruits contained significant amount of zingiberene (6.3%). The largest amount of t-muurolol (13.0%) was found in the flower oil. Other authors reported that the main constituents of essential oils from the leaves and fruits of *A. muricarpum* (Huong et al. 2015) were found to be linalool (40.4 and 25.6%) and nerolidol (22.3 and 49.4%), respectively.

Information obtained from data on the previous analysis of the chemical constituents of essential oils some *Amomum* plants growing all over the world revealed that monoterpene and sesquiterpene compounds predominate. However, the identities of these terpene compounds differed from one species to another. However, a noteworthy observation was that zerumbone a major compound of *A. gagnepainii* leaf oil was not previously reported as a significant constituent of any of the *Amomum* oils. Comparing the present data with previous studies, it could be seen that the compositions of *Amomum* oils growing in Vietnam may be classified as (i) oils containing large amount of monoterpene hydrocarbons mainly *A. reopense* (leaf), *A. muricarpum* (leaf), *A. maximum* (leaf and root), *A. villosum* (leaf, root and fruit); (ii) oils dominated by sesquiterpene hydrocarbons as seen in *A. maximum* (leaf, stem, root and fruits), *A. longiligulare* (stem); (iii) oil samples with combined quantity of both monoterpene and sesquiterpene hydrocarbons found in *A. aculeatum* (leaf) and *A. longiligulare* (leaf); (iv) the seeds of *A. villosum* consist mainly of oxygen-containing monoterpenes; (iv) the leaf composition of *A. gagnepainii* was rich in oxygenated sesquiterpene compounds; fatty acids are found only in the roots of *A. longiligulare*.

It is well known that the biological activity of an essential oil may depend on the major constituent(s) or a synergy between a major and some minor compounds. The compounds identified in the studied oil samples may therefore play a greater role in the biological potentials of the essential oils. For example, several biological activities such as anti-inflammatory, antibiotic, antioxidant, anticarcinogenic, local anaesthetic, anticancer (Legault and Pichette

2007; Amiel et al. 2012) and antileishmanial (Soares et al. 2013) are attributed to β-caryophyllene. Zerumbone has shown anti-bacterial and antiproliferative effect towards cervical cancer cell lines (Abdul et al. 2008a), anti-inflammatory activity (Chien et al. 2016) and anti-cholinesterase effect (Abdul et al. 2008b). The antimicrobial (Shin et al. 1997) and insect repellent (Seyoum et al. 2003) activities of farnesyl acetate have been reported. The antimicrobial activity of α- and β-pinene (da Silva et al. 2012), cytotoxicity, anti-inflammatory, antiproliferative, anti-invasive and antiangiogenic potentials of α-pinene (Bansal et al. 2007; Bhattacharjee and Chatterjee 2013), anticancer activity of β-pinene (Bourgou et al. 2010) and cytotoxicity potential of γ-terpinene (Ferraz et al. 2013) were reported. (*E*)-β-Ocimene acts as a pheromone (Maisonnasse et al. 2010).

The biological activities of essential oils from some *Amomum* plants have been reported. *Amomum sublatum* essential oil containing 1,8-cineole, β-pinene and α-terpineol displayed allelopathic, brine shrimp lethality, antimicrobial, insecticidal and nematocidal effects (Satyal et al. 2012) while *A. biflorum* with contents of camphor and α-bisabolol also show antibacterial property (Singtothong et al. 2013). Other *Amomum* oils containing varying degrees of major constituents have displayed interesting biological potentials (Sabulal et al. 2007; Yang et al. 2010; Pawitra et al. 2012; Wang et al. 2014). This indicated that the essential oils of *Amomum* plants exhibited varying degrees of biological potentials depending on the chemical constituents.

3. Conclusions

For the first time, the compositional patterns of essential oils from *A. gagnepainii* and *A. repoense* grown in Vietnam were reported. It was observed that *A. gagnepainii* consisted mainly of sesquiterpenes while *A. repoense* comprised of monoterpene compounds. The compositions of the oil samples were found to be different from those of other members of the genus.

Supplementary material

Experimental details relating to this paper are available online, alongside Table S1.

Disclosure statement

No potential conflict of interest was reported by the authors.

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