

## Seasonal Variation of Mono- and Sesquiterpenes in the Essential Oil of *Pycnocycla spinosa* Decne. Exboiss.

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### Abstract

*Pycnocycla spinosa* aerial parts were collected weekly during four-month growth. Hydrodistillation and gas chromatography coupled with mass spectroscopy techniques were used for essential oil and sesquiterpenes investigation. Thirty-four components were identified, of which the characteristic sesquiterpenes were  $\alpha$ -copaene, caryophyllene,  $\alpha$ -humulene,  $\beta$ -ionene, d-cadinene,  $\alpha$ -calacorene, caryophyllen oxide,  $\alpha$ -cadinol, and  $\beta$ -eudesmol. The content of  $\beta$ -eudesmol in the essential oil varied 1.9-9.17%, and of  $\alpha$ -cadinol did 0-5.59%. Plant harvested in Jun provided essential oil with high caryophyllen oxide. These results may indicate that essential oil of differ qualities can be obtained according to the harvest time of the plant.

**Keywords:** *Pycnocycla spinosa*; Seasonal variation; Sesquiterpenes.

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### Introduction

The genus *Pycnocycla* (Umbelliferae), an aromatic plant, is distributed in central parts of Iran [1]. It is generally assumed that the material is best collected when the organ in question has reached its optimal state of development, based on such assumptions herbs are collected at the flowering stage. The variation in the content of secondary metabolites is important for the interaction of plants with pathogens and herbivores [2]. Literature search has not revealed any previous work on the seasonal variation in the essential oil of *P. spinosa*. However, fruit oil from *P. spinosa* has been studied, in which  $\beta$ -eudesmol is found to predominate [3].

There are several reports that the concentration of terpenoids in aromatic plants varies during the day and season [4, 5]. Although monoterpenes predominate in most essential oils, many also contain sesquiterpenes.

Many sesquiterpenes play defensive roles in plant-insect and plant-fungal interactions [6].

### Experimental

#### Plant Materials

*Pycnocycla spinosa* was collected from Isfahan University campus and was identified by the botanist Mr. Mehregan in Department of Biology at Isfahan University. A voucher specimen (A24) was authenticated and then deposited in the herbarium of Faculty of Pharmacy and Pharmaceutical Sciences, Isfahan, Iran. *Pycnocycla spinosa* aerial parts were collected weekly between May 29 and September 17, 2000. To eliminate the effect of diurnal variation the samples were collected at the same time (10:0 am) every day. The essential oils were obtained by hydrodistillation for 4 h according to the British Pharmacopoeia [7].

#### Analysis

The hydrodistilled aerial parts oils of *P. spinosa* were analyzed by Gas

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Table 1. The seasonal variation in sesquiterpenes content, relative (%), in the essential oil of *P. spinosa*

Date	$\alpha$ -copaene	caryophyllene	$\alpha$ -humulene	$\beta$ -ionene	$\delta$ -cadinene	$\alpha$ -calacorene	caryophyllen oxide	$\alpha$ -cadinol	$\beta$ -eudesmol
29/05/00	0.67	0	0	0	0	0.62	0	3.26	9.17
06/06/00	0.36	1.11	0.41	0.24	0.67	0.25	4.09	1.12	3.25
13/06/00	0.52	0.98	0.65	0.44	1.52	0.56	5.88	2.3	6.63
20/06/00	0.33	0.29	0.3	0.26	0.54	0.39	0	1.55	4.97
26/06/00	0.26	1.44	0	0.18	0.47	0.26	0	1.14	5.11
17/07/00	0.28	1.71	0	0.14	0.36	0	0	0.65	1.91
24/07/00	0.35	0.82	1.11	0.28	0.5	0.16	3.18	0.98	5.12
31/07/00	0.43	1.57	0.78	1.36	1.56	0	0	0.58	2.10
07/08/00	0.51	0	1.53	0.66	0.44	0.46	2.69	3.2	2.59
14/08/00	0.54	0.97	2.59	0.29	1.27	0.47	4.83	5.59	6.67
21/08/00	0.40	1.62	0	0	1.35	0.27	0	3.86	3.48
10/09/00	0.58	0.83	0	0	0.32	0	0	0	3.46
17/09/00	0.22	0	0.95	0	0.18	0.30	0	1.10	2.84

chromatography (GC) and Gas chromatography coupled with mass spectroscopy (GC-MS). GC analysis was carried out on a Perkin-Elmer 8500 gas chromatograph with FID detector and a BP-1 capillary column (39m x 0.25mm; film thickness 0.25  $\mu$ m). The carrier gas was helium with a flow rate of 2 ml/min, the oven temperature for first 4 min was kept at 60°C and then increased at a rate of 4°C /min until reached to the temperature of 280°C, injector and detector temperatures were set at 280°C.

Confirmation of peak identity was effected by co-chromatography with standards and GC-MS. The mass spectra were recorded on a Hewlett Packard (HP) 6890 MS detector coupled with Hewlett Packard 6890 gas chromatograph equipped with HP-5MS capillary column (30m x 0.25mm; film thickness 0.25 $\mu$ m). The gas chromatography condition was as mentioned previously. Mass spectrometer condition was as follow: ionized potential 70 eV, source temperature 200°C [8, 9].

### Results and Discussion

Nine identified sesquiterpenoid constituents were  $\alpha$ -copaene, caryophyllene,  $\alpha$ -humulene,  $\beta$ -ionene,  $\delta$ -cadinene,  $\alpha$ -calacorene, caryophyllen oxide,  $\alpha$ -cadinol, and  $\beta$ -eudesmol. Seasonal variations( May to September) of sesquiterpenoid components were shown in Table 1. The most abundant sesquiterpenes were caryophyllen oxide,  $\alpha$ -cadinol, and  $\beta$ -eudesmol, all of which showed great seasonal variations. Several studies carried out on aromatic plants have shown that essential oil composition may vary considerably throughout a year [10, 11]. From Table 1 it can be seen that the content of  $\beta$ -eudesmol in the essential oil in

different season varied 1.9-9.17%, and of  $\alpha$ -cadinol did 0-5.59%. Evaluation of sesquiterpenoid components showed maximum concentration (percent of essential oil) of caryophyllen oxide in Jun. Seasonal variation has also been noticed for *Hymenaea courbaril*, *Copaifera officinalis*, and *Copaifera pubiflora*, who's content of sesquiterpenes varies greatly during the year [12]. Variation in the sesquiterpene hydrocarbons,  $\alpha$ -copaene, caryophyllene,  $\alpha$ -humulene,  $\beta$ -ionene,  $\delta$ -cadinene,  $\alpha$ -calacorene due to season were not significant. It may indicate no correlation exists between sesquiterpene hydrocarbons content and the level of oxygenated sesquiterpenes. This study showed the time in which the plant contained the largest amount of the desired mono- and sesquiterpenes, so that these components can be collected or harvested accordingly.

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