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Effect of physical factors on the volatile constituents of *Cinnamomum zeylanicum* stem bark

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ABSTRACT

The chemical composition of the essential oil obtained from dried stem bark of *Cinnamomum zeylanicum* Blume (Lauraceae) of Delhi region was analyzed by gas liquid chromatography (GLC) and gas chromatography mass spectrometry (GC-MS). The variations in essential oil components under different physical factors have been determined. The volatile components of the stem bark of *C.zeylanicum* was characterized mainly by cinnamic aldehyde (93.1%) followed by monoterpene l-limonene (3.1%) and sesquiterpenes, viz. 3, 7-guaiadene, cis-calamenene and caryophyllene oxide. Treatment of the oil with alumina enhanced the production of cinnamic aldehyde (97.8%). Except the volatile oil treated with heat and alumina neutral, α-pinene was detected in all the oil samples and its amount varied from 0.2% in normal, sunlight and UV light to 1.1% in silica gel treated oil. l-Limonene was present in all the oil samples and its concentration markedly differed from 0.4% in the alumina treated sample to 14.2% in the silica gel treated oil.

KEYWORDS

Cinnamomum zeylanicum;
Lauraceae;
Physical factors;
Chemical composition variations.

INTRODUCTION

Cinnamomum zeylanicum Blume (Lauraceae), commonly known as cinnamon, is one of the oldest and most valuable items in the spice trade. It is a tree growing in tropical regions, which is native to China, western India and Sri Lanka and also distributed in several tropical countries, including Madagascar, West Indies, Malaysia and Java[1]. Cinnamon holds a reputed position as medicinal herb in different systems of medicine in India. The essential oil of cinnamon is utilized in food preparations, perfumery, health food medicines and beverages[2]. The oil possessed antifungal, antibacterial, antiparasitic, antispasmodic, antiflatulent, appetite stimulant, antioxidant, antidiarrhoeal, refrigerant and anthlemintic properties[3-5]. The chemical composition of essential oil of cinnamon have been reported earlier[6-7]. The present work describes the effect of different physical factors on the chemical composition of essential oil of *C.zeylanicum.*

EXPERIMENTAL

Plant material

The dried stem bark of *Cinnamomum zeylanicum* were purchased from the Sangam Vihar market, New-

Delhi. The plant material was identified by Dr. M.P.Sharma, Reader, Department of Botany, Jamia Hamdard. A voucher specimen is preserved in the herbarium of the Department of Pharmacognosy and Phytochemistry, Faculty of Pharmacy, Jamia Hamdard, New-Delhi.

Isolation of the volatile oil

The dried stem bark pieces (1 kg) of *C.zeylanicum* were hydrodistilled in all glass Clavenger apparatus according to the method recommended in the British Pharmacopoeia, 1988. The colourless volatile oil was dried over anhydrous sulphate and stored at 4^0C in the dark. The yield was 3.25 % based on the weight of the dried fruits.

Thermal effect on the volatile oil

The volatile oil (3 ml) of *C.zeylanicum* was heated in a sealed vial at 110^0C in an electric hot oven for 24 hours. After cooling the oil was stored in the dark at 4^0C.

Sunlight effect on the volatile oil

The volatile oil (3 ml) of *C.zeylanicum* was exposed to sunlight for 48 hours at 15^0C in a glass vial. After exposure, it was stored in the dark at 4^0C.

Ultraviolet light effect on volatile oil

The volatile oil (3 ml) of *C.zeylanicum* was exposed to ultraviolet light for 24 hours at 12^0C in a glass vial. After exposure, the oil was stored in the dark at 4^0C.

Treatment of the volatile oil with silica gel-G

The volatile oil (3 ml) of *C.zeylanicum* was treated with silica gel-G in a sealed glass vial for 24 hours at 12^0C. It was dissolved in solvent ether, filtered and the solvent evaporated under reduced pressure on a steam bath. The treated volatile oil was stored in the dark at 4^0C.

Treatment of the volatile oil with alumina neutral

The volatile oil (3 ml) of *C.zeylanicum* was treated with alumina neutral in a sealed glass vial for 24 hours at 12^0C. It was dissolved in solvent ether, filtered and the solvent evaporated under reduced pressure on a hot steam bath. The treated volatile oil was stored in the dark at 4^0C.

GC analysis

Analytical GC was carried on a Varian 3300 gas chromatography fitted with a silicon DB-1 capillary column (30 m × 0.25 mm), film thickness 0.25 μm; carrier gas nitrogen, flow rate 1.5 ml/min, split mode, temperature programmed 80-225^0C at 4^0C/min. Injector temperature 250^0C, detector used FID, detector temperature 300^0C. Injection volume for all samples was 0.1μl.

GC-MS analysis

GC-MS analysis were carried out on a QP-2000 instrument fitted with a fused silica column Ulbon HR-1 (25 m ×0.22 mm), film thickness 0.22μm and FID, carrier gas He, flow rate 1.5ml/min. The initial temperature was 100^0C for six minutes and then heated at a rate of 10^0C per minute to 250^0C. The chromatograph was coupled to a HP 5971 A mass selective detector (70 eV).

Identification of constituents

The most constituents were identified by GC by comparing their retention indices with those of authentic standard available in the laboratory which were in close agreement with the reference samples. Further identification was achieved by GC/MS. The fragmentation patterns of mass spectra were compared with those stored in the spectrometer data base using the NBS 54 KL and Wiley L-built libraries and with those reported in the literature[8-14].

RESULTS AND DISCUSSION

The volatile components of the dried stem bark of C.zeylanicum was characterized mainly by cinnamic aldehyde (93.1%). There were six monoterpenes (4.6%) and five of them were monoterpene hydrocarbons (4.4%). The predominant monoterpene was l-limonene (3.1%). There were three sesquiterpenes, viz. 3, 7-guaiadene, cis-calamenene and caryophyllene oxide, all of them was present in trace amounts. In addition to cinnamic aldehyde, the other aromatic components detected were benzaldehyde, o-cymene, eugenol and (E)-methyl cinnamate, all of them occurred in lesser than 1% yield. The oil was devoid of any aliphatic constituent.

TABLE 1: Comparative variation of the volatile oil components of the *C.zeylanicum* after different treatment

S.no.	Components	Retention indices	A %	B%	C %	D %	E %	F %
1	α- Pinene	925	0.2	---	0.2	0.2	1.1	--
2	β-Pinene	964	0.2	0.1	0.1	0.1	0.7	---
3	Sabinene	965	---	---	---	---	0.3	---
4	Benzaldehyde	967	0.5	0.2	0.6	0.5	---	0.2
5	l-Limonene	1017	3.1	1.0	3.3	2.9	14.2	0.4
6	cis-Ocimene	1019	0.1	---	---	0.1	0.4	---
7	o-Cymene	1023	0.8	0.9	0.1	0.7	0.6	0.6
8	Thujyl alcohol	1125	0.2	---	---	0.2	---	---
9	Cinnamic aldehyde	1210	93.1	95.6	92.8	93.1	77.6	97.8
10	Longipinene	1258	---	---	---	---	1.5	---
11	Terpinen-4-yl acetate	1282	---	---	---	----	0.1	---
12	Eugenol	1326	0.5	0.7	0.6	0.9	---	0.7
13	α-Copaene	1364	---	---	0.3	---	0.2	---
14	3,7-Guaiadene	1430	0.3	0.5	0.4	0.3	1.4	0.1
15	cis-Calamenene	1451	0.4	---	0.5	---	1.7	---
16	β-Selinene	1471	---	0.4	---	---	---	---
17	γ-Cadinene	1502	---	0.4	---	0.5	---	0.1
18	(E)–Methyl cinnamate	1507	0.5	---	---	0.4	---	---
19	Caryophyllene oxide	1520	0.2	0.3	0.3	0.2	0.2	---

A =Volatile oil without treatment (Normal); B= Volatile oil heated at 110^0C for 24 hours, C= Volatile oil exposed to sun light for 48 hours; D= Volatile oil exposed to UV light for 24 hours; E= Volatile oil treated with silica gel for 24 hours; F= Volatile oil treated with alumina neutral for 24 hours

A comparative variation of the volatile oil components of the stem bark of C. zeylanicum after different treatments is presented in TABLE 1. The concentration of α-pinene varied from 0.2% in normal, sunlight and UV light exposed oil to 1.1% in the silica gel treated sample and it was absent in the heated and alumina neutral treated samples. Except alumina (neutral) treated sample, β- pinene was characterized in all oil samples and its level differed from 0.1% to 0.7% in the silica gel treated sample. Sabinene (0.3%), longipinene (1.5%) and terpinen-4-yl acetate (0.1%) were detected in the oil sample treated with silica gel. Except silica gel treated sample, benzaldehyde was present from 0.2% to 0.6% yield in other oil samples. l-Limonene was present in all the oil samples and its concentration markedly differed from 0.4% in the alumina treated sample to 14.2% in the silica gel treated oil. *cis*-Ocimene was detected in the normal, UV light exposed and silica gel treated samples from 0.1% to 0.4% yield. *o*-Ocimene was present in all the oils and its level varied slightly from 0.1% in the sunlight exposed sample to 0.9% in the heated oil. Thujyl alcohol was detected in 0.2% yield each in normal and UV light exposed samples. Cinnamic aldehyde was the prominent component of the oil samples and its concentration markedly varied from 77.6% in the silica gel treated oil to 97.8% in the alumina treated oil sample. The concentration of eugenol differed from 0.5% in the normal oil to 0.9% in the UV light exposed sample and it was absent in the silica gel treated sample. α-Copaene was only characterized in the sunlight exposed and silica gel treated sample in 0.3% and 0.2% yields, respectively.

3, 7-Guaiadene was detected in all the oil samples and its amount varied from 0.1% in the alumina treated oil to 1.4% in the silica gel treated oil sample. The level of *cis*-calamenene differed from 0.4% in the normal oil to 0.5% in the sunlight exposed and 1.7% in the silica gel treated oil whereas in all other oil samples it could not be detected. β-Selinene was only characterized in the heated oil sample. Cadanene was generated in trace amounts only in the oil samples heated at 110^0C, exposed to UV light and treated with alumina neutral. (E)-Methyl cinnamate was only detected in the normal and UV light exposed samples in trace amounts. Except the alumina treated sample, caryophyllene oxide was detected in all oil samples in trace amounts.

In conclusion, the essential oil obtained after exposure to different physical factors varied in chemical components and their relative amounts. These qualitative and quantative differences of oil components might be because of the interference of the components of the oil with light, heat and chromatographic adsorbents. Thus, by using these trials, it is possible to increase the quality and quantity of content and composition of the essential oil for industrial, nutritional and biological purposes.

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