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Research Article

ANALYSIS OF THE ESSENTIAL OILS OF THE STEMS, LEAVES AND RHIZOMES OF THE MEDICINALPLANT *COSTUS PICTUS* FROM SOUTHERN INDIA

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ABSTRACT

The medicinal plant *Costus pictus* (Zingiberaceae family) is well known for its antihyperglycemic and insulin secretory activity. In this study, the essential oils of the stems, leaves and rhizomes of *Costus pictus* from southern India were investigated by GC-MS. The essential oil of *Costus pictus* stem is rich in hexadecanoic acid (28.3%), 9,12-octadecadienoic acid (18.33%), linalyl propanoate (6.03%), dodecanoic acid (5.62%), tetradecanoic acid (4.82%), α-eudesmol (3.55%), γ-eudesmol (3.21%) and 4-ethoxy phenol (3.06%). The leaf essential oil contains hexadecanoic acid (24.51%), 2-pentanol (22.48%), β-ionone (8.69%), α-ionone (8.01%), farnesyl acetone (7.04%) and dodecanoic acid (3.96%). Hexadecanoic acid (25.26%), dodecanoic acid (16.56%), tetradecanoic acid (10.20%), linalool (8.48%), 9, 12-octadecadienoic acid (7.74%), and α-terpineol (4.44%) are the main constituents of the rhizome essential oil. Hexadecanoic acid (palmitic acid), the chief constituent of *Costus pictus* leaf oil, has been recognized as the precursor for the development of coronary heart diseases and therefore the constant use of *Costus pictus* leaves for the diabetic treatment by the people in Kerala, South India cause serious health hazards and it must be avoided.

Key words: *Costus pictus*, Essential oils, Stem, Leaf, Rhizome, GC-MS.

INTRODUCTION

Costus pictus (Zingiberaceae family) is a native of south and central America. It is widely cultivated in south India and also run wild in many places. This is a recent introduction from America as a herbal cure for diabetes, hence commonly called as 'insulin plant.' Though not clinically proved, it is widely used as a remedy for diabetes[1]. Powdered leaves of the medicinal plant *Costus pictus* known to possess therapeutic effect, when supplemented to streptozotocin induced diabetic rats, is found to reduce blood glucose level by 21% after 15 days of supplementation[2]. The methanolic leaf extract of *Costus pictus* is used to lower blood glucose level in alloxan induced diabetic rats[3]. The antihyperglycemic and insulin secretory activity of an aqueous extract of *Costus pictus* leaf is investigated in streptozotocin induced diabetic rats[4]. The chemical composition of essential oils of *Costus pictus* has not been reported yet. Therefore the chemical constituents of essential oils from stems, leaves and rhizomes of *Costus pictus* were analysed using GC-MS.

MATERIALS AND METHODS

Plant material

The stems, leaves and rhizomes of *Costus pictus* were collected in December 2009 from Thrissur district of Kerala, South India and authenticated by Dr. A.K. Pradeep, Dept. of Botany, Calicut University. Voucher specimen is deposited in the specially maintained herbarium, Department of Chemistry, Calicut University.

Extraction of essential oils

The fresh stems (610g), leaves (420g) and rhizomes (580g) of *Costus pictus* were cut into small pieces and ground to a paste using an electric mixer grinder and subjected to steam distillation for three hours. About 2L of the distillates were collected and extracted with diethyl ether (3X100 mL) and dried over anhydrous sodium sulphate and the solvent was removed by evaporation. (The yields were 0.35% for the stem oil, 1.6% for the leaf and 0.45% for the rhizome oil).

Gas chromatography – mass spectrometry

The GC-MS analyses were carried out on Agilent 6890 GC system equipped with a 5973 inert mass selective detector (Agilent Technologies, USA). A CO Sil 8 CB (Varian, Middleburg, Netherlands) column of 30m length, 0.25mm i.d, and 0.25µm film thickness was used. The oven was programmed from an initial temperature 50^{0}C (hold for 2 min) to the final temperature 280^{0}C at the rate of 10^{0}C/min. The final temperature hold up time was 5 min. Helium at the rate of 1 mL/min was used as the carrier gas in constant flow mode. The inlet and interface temperatures were kept at 280^{0}C. The EI source was operated at 230^{0}C and the quadrupole temperature was 150^{0}C. The MS was scanned from 30 to 500 mass units. One micro litre of the sample was injected in split mode at a split ratio of 10:1. For compound identifications, Wiley 275 library spectra were used (online).

RESULTS AND DISCUSSION

The steam distillation of the stems, leaves and rhizomes of *Costus pictus* yielded clear and yellowish essential oils. The chemical constituents identified by GC-MS in the essential oils of stems, leaves and rhizomes of *Costus pictus* are listed in Table 1. The major constituents identified in the stem oil of *Costus pictus* were hexadecanoic acid (28.3%), 9,12-octadecadienoic acid (18.33%), linalyl propanoate (6.03%), dodecanoic acid (5.62%), tetradecanoic acid (4.82%), α-eudesmol (3.55%), γ-eudesmol (3.21%), and 4-ethoxy phenol (3.06%). The leaf oil contained hexadecanoic acid (24.51%), 2-pentanol (22.48%), β-ionone (8.69%), α-ionone (8.01%), farnesyl acetone (7.04%) and dodecanoic acid (3.96%) as important constituents; whereas hexadecanoic acid (25.26%), dodecanoic acid (16.56%), tetradecanoic acid (10.20%), linalool (8.48%), 9,12-octadecadienoic acid (7.74%), and α-terpineol (4.44%) were the main compounds in the rhizome essential oil.

The essential oils of stems, leaves and rhizomes of the medicinal plant *Costus pictus* contained hexadecanoic acid (palmitic acid) as the major constituent. Palmitic acid cause high LDL (Low Density Lipoprotein) cholesterol levels and raise the LDL to HDL ratio in healthy adults. High levels of LDL cholesterol increase the risk for coronary heart diseases[5]. Consumption of foods rich in saturated fatty acids and cholesterol has long been recognized as an important precursor for the development of coronary heart disease and saturated fatty acids elevate LDL concentration in the blood[6]. Moreover palmitic acid induces degeneration of myofibrils in rat adult cardiomyocytes. Exposure of adult rat cardiomyocytes to palmitic acid for 18 hours destroyed both the contractile elements and the cytoskeleton. The deleterious effect of palmitic acid on myofibrils preceded DNA fragmentation and was detectable 3h after administration of palmitic acid[7]. Palmitic acid, being the major component of the *Costus pictus* leaf oil, the constant use of *Costus pictus* leaves for diabetic treatment by the people in Kerala, India cause serious health hazards and it must be avoided.

Table 1: Essential oil composition of stems, leaves and rhizomes of *Costus pictus*

Identified compounds	Percentage composition		
	stem	leaf	rhizome
cis-Linalool oxide	2.53	--	--
Linalool	1.16	--	8.48
Linalyl propanoate	6.03	--	--
Decanoic acid	0.34	--	--
4-Ethoxy ethyl benzoate	4.44	--	--
Dodecanoic acid	5.62	3.96	16.56
γ-Eudesmol	3.21	--	--
α-Eudesmol	3.55	--	--
Tetradecanoic acid	4.82	--	10.20
2,4-di-tert-butyl Phenol	2.24	--	--
Pentadecanoic acid	1.01	--	0.64
Hexadecanoic acid	28.30	24.51	25.26
Phytol	1.18	--	--
9,12-octadecadienoic acid	18.33	--	7.74
Octadecanoic acid	2.94	--	--
4-ethoxy Phenol	3.06	--	--
4-vinyl-2-methoxy Phenol	1.5	--	--
Isophytol	1.02	--	--
1,1-diethoxy Ethane	--	0.31	--
cis-3-Hexenol	--	1.41	--
2-ethoxy Butane	--	1.25	--
2-Pentanol	--	22.48	--
Tetradecane	--	0.34	--
β-Ionone	--	8.69	--
α-Ionone	--	8.01	--
n-Nonadecane	--	2.94	--
Farnesyl acetone	--	7.04	0.84
α-Terpineol	--	--	4.44
9,12-Octadecadien-1-ol	--	--	1.83

CONCLUSION

The present study represents the comprehensive analysis of volatile constituents of *Costus pictus* stems, leaves and rhizomes. Palmitic acid is found to be the major component in the stem, leaf and rhizome oils of *Costus pictus.* Palmitic acid induces degeneration of myofibrils in rat adult cardiomyocytes, enhance LDL to HDL cholesterol ratio in healthy adults and it is found to be the important precursor for the development of coronary heart diseases. So the constant use of *Costus pictus* leaves for diabetic treatment by the people in Kerala, India will cause serious cardiac diseases and it is not recommended for the treatment.

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