SRI LANKAN MEDICINAL PLANT

MONOGRAPHS AND ANALYSIS

VOLUME – 1

KAEMPFERIA GALANGA

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PREFACE

The medicinal plants of Sri Lanka have been investigated in the Natural Products Development group for nearly two decades. This monograph which is the first in this series is the result of the literature surveys, researches, and experiences of the Natural Products Development Group of Industrial Technology Institute (Ceylon Institute of Scientific & Industrial Research) This is intended for varied reading public, the herbal drug manufacturers who need to identify and standardise their herbal raw materials, the Ayurvedic physicians who need some scientific information on medicinal plants, the research workers requiring a quick background on a plant, the industrialist or entrepreneur pondering on commercial ventures and the inquiring lay readers. We hope this monograph fulfils some requirements of each of these

The authors wish to thank all the members of Natural Products Development group who contributed to this and gratefully acknowledge the sponsor National Science Foundation for Research Grant RG/98/IS/01.

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KAEMPFERIA GALANGA

Other Names	-	Sans - Chandramulika, Sugandhavacha; Hindi - Chardramula; Beng - Chandumula; Mar - Kachri, Kapur-kachri; Tel - Kachoram; Tam -- Kacholam, Kacholakilongu; KanKachchura; Mal - Katjulam, Kacholam[1].
Sinhalese name	-	Hinguru piyali
Family	-	Zingiberaceae
Part Used	-	Rhizome and roots
Pharmacopoeia	-	Ayurveda Pharmacopoeia [2] Sinhalese Material Medica [3] Indian Material Medica [4]
Official drugs	-	Powder, Oil [2]
Uses in Traditional Medicine	-	In Sri Lanka rhizome of this plant mixed with oil is used externally for healing of wounds and applied to warm rheumatic regions[1]. The sliced rhizome tied as a poultice hastens suppuration of boils[1]. A lotion prepared from the rhizome is used to remove dandruff or scales from the head[1]. The powdered rhizome mixed with Bees honey is given for coughs and pectoral ailments[1]. In Philippines a decoction of the rhizome is taken as a tonic and also used in dyspepsia, headache and malarial chills. It is also used as a gargle[5].

The rhizomes are applied externally to remove nasal obstruction. They are also used for relieving irritation produced by caterpillars. Mixed with oil the rhizome is used as a cicatrizant[5].

In Malaysia they are used for chills in elephants. The juice of plant is an ingredient of some tonic preparations[5].

The leaves are used in lotions and poultices for sore-eyes, rheumatism and fever in Malaysia[5].

Dried rhizome of this plant is used as a cardiotonic in Thailand[6].

In India the dried rhizomes of *K. galanga* and a mixture of some other plants including *Piper longum* are used for heart disease[7].

In Papua New Guinea the rhizome is used orally as an abortifacient [8]

In China dried entire plant of *K. galanga* is used as a medicine for adult human beings[6].

The plant is also used for treatment of abdominal pain, vomiting, diarrhoea, toothache with the functions of promoting vital energy circulation and alleviating pain in India[6].

Other Uses - The herb is used as flavouring for food in Malaysia and for perfumery in India[9,10].

Rhizome and leaves are employed as perfume in hair washes, powders and other cosmetics[10].

The rhizomes are worn by women for fragrance and also used for protecting clothes against insects. They are eaten along with betel and arecanuts as a masticator[2,10].

Distribution - Cultivated in home gardens in Sri Lanka, and also in India, Malaysia, Moluccas, and Philippine Islands[1].

Morphology

A small herb with an aromatic, tuberous rootstock and fleshy, cylindrical root fibres which are not aromatic; leaves few, 2 spreading horizontally, lying flat on the surface of the ground, broad, rotund – ovate; deltoid – acuminate, thin deep green, 10 – 12 ribbed, margins not thickened not coloured, petioles short channeled; flowers irregular, bisexual, white, 6-12 from the centre of the plant between the leaves, fugacious, fragrant, opening successively, bracts lanceolate, green, short; calyx long as the outer bracts, short cylindrical; petals 3, corolla tube 2.5 cm long, lobes equal, usually spreading, lanceolate, pure white; stamen one, perfect, filament short, arcuate, anther two- celled, cells discreet[1].

Fig - 1

K. galanga plant

1. Leaf 2. Rhizome 3. Root

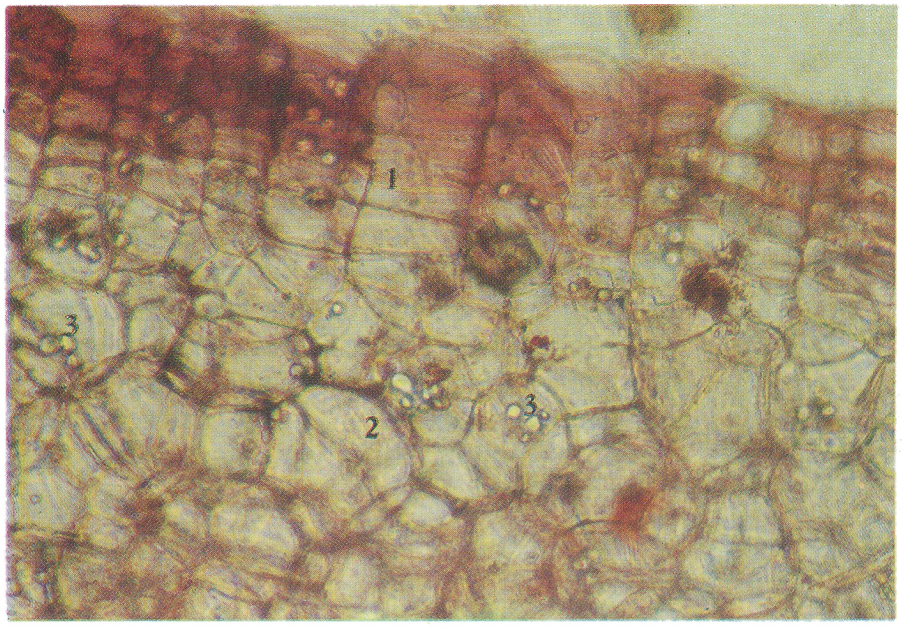


Fig – 2

Cross section of *K. galanga* rhizome

1. Cork 2. Cortex 3. Starch granules

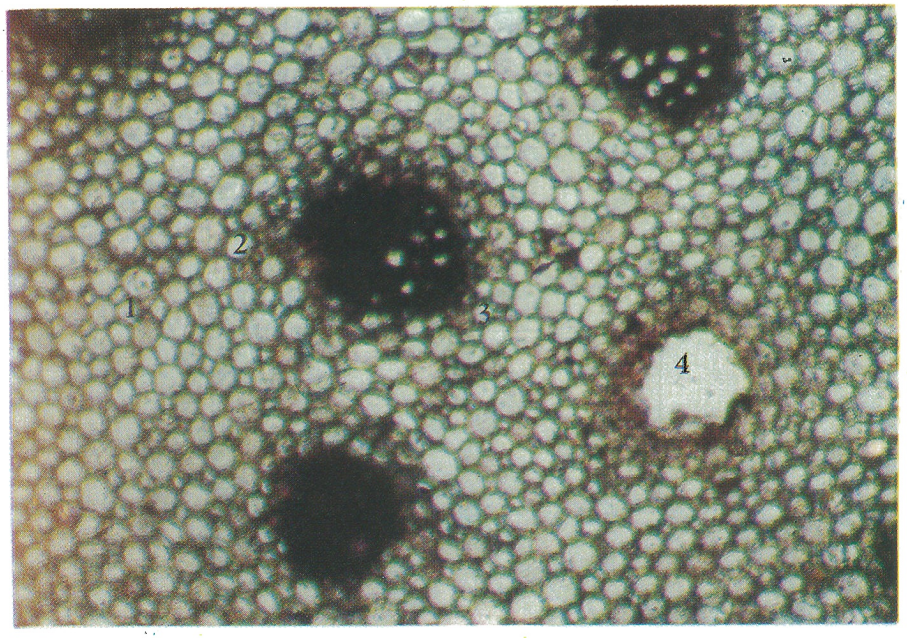


Fig - 3

Cross section of *K. galanga* root

1. Cortex 2. Phloem 3. Xylem 4. Pith cavity

ANALYTICAL SPECIFICATION

Powder Analysis

Macroscopic characters

Colour	-	Brown
Odour	-	Camphoraceous odour
Taste	-	Bitter aromatic taste

Microscopic character

K. galanga root and rhizome show,

Thin walled parenchyma cells.
Fragment of thick walls of tracheids and part of tracheid, wilt irregular shape parenchyma cells and their parts.
A number of starch granules that have come out from the cells.

Table - 1 Physico -Chemical Analysis

Test	Limits
Ethanolic extract of rhizome	14.5-18.5%
Ash content of rhizome	<4.7%
Acid insoluble ash of rhizome	<0.86%
Ethanolic extract of root	12-16%
Ash content of root	<9.36%
Acid insoluble ash of root	<0.66%

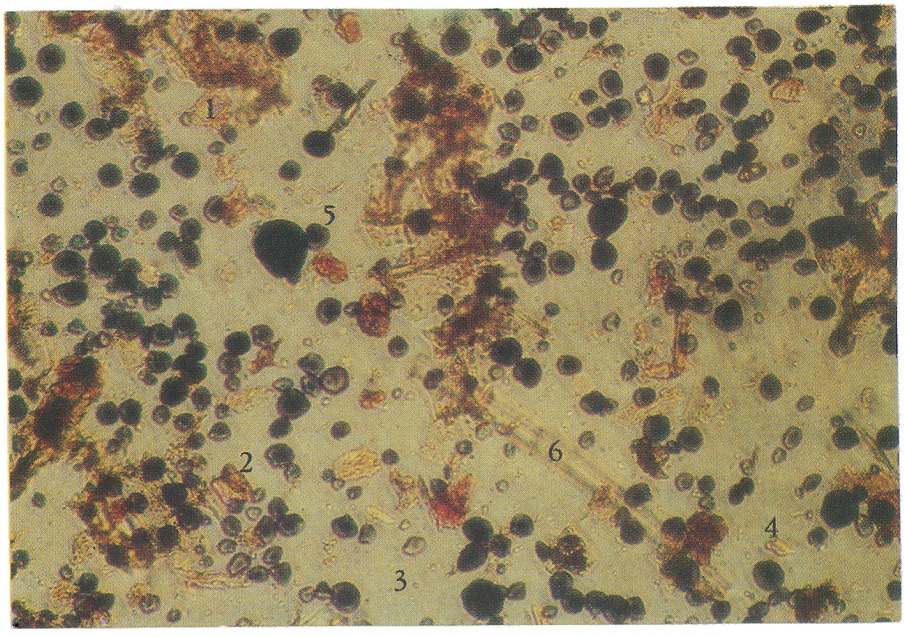


Fig – 4

Powder of *K. galanga* rhizome under the microscope

1. Parenchyma cell
2. Tracheid
3. Cell content
4. Part of a cell
5. Starch granules
6. Fibre

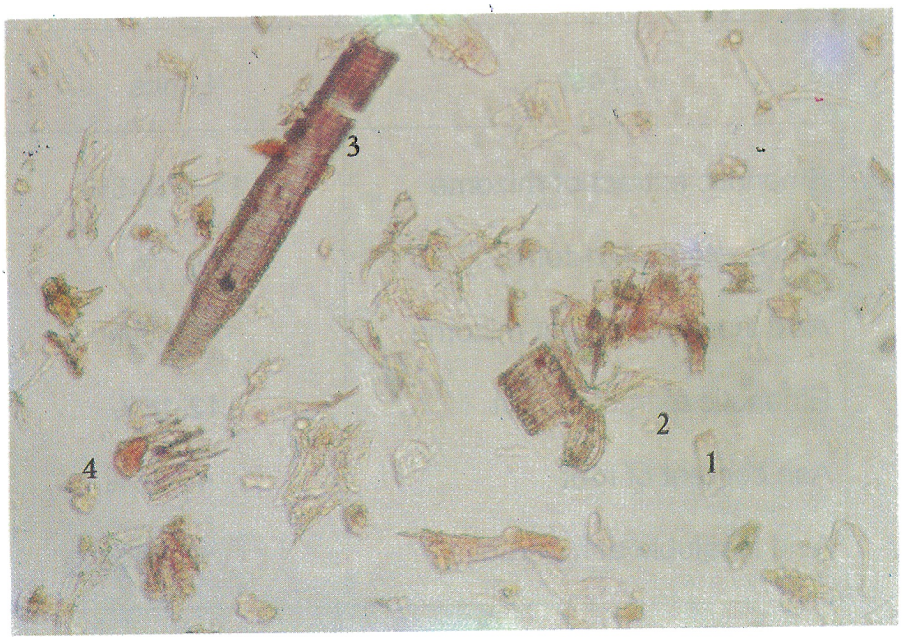


Fig – 5

Powder of *K. galanga* root under the microscope

1. Parenchyma cell
3. Cell content
2. Tracheid
4. Part of a cell

PHYTOCHEMISTRY

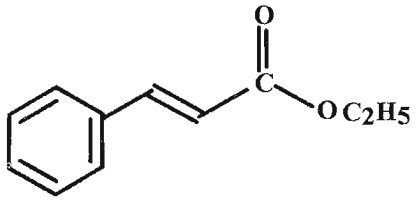
K. galanga leaves contain, kaempferol, quercetin, cyanidin, delphinidin[7].

K. galanga rhizome contains' , ethyl cinnamate, ethyl p–methoxy cinnamate, p–methoxy cinnamic acid, camphene, δ -3–carene, p– methoxy styrene, car-3– en –5–one, sandaracopimaradiene–9–ol–1–one, sandaracopimaradiene–1,9–diol, 6 –acetoxy sandaracopimaradiene–9–ol–1–one, sandaracopimaradiene– 6,9– diol 1–one, 6–acetoxy sandaracopimaradiene-1,9–diol, sandaracopimaradiene–1,6,9 –triol. γ-pinene, β-myrcene, p–cymene, 1,8–cineol, isomyrcene, camphor, borneol, α-terpineol, p–cymene–8–ol, eucarvone, piperitenone, tridecane, pentadecane, δ-cadinene, hexadecane, heptadecane, limonene, octanol, tetradecane, 2,3–dihydrobenzofuran, indol, vanillin, p–methoxy phenol, carvacrol, carveol, myrtenol, β-cymene, benzaldehyde, p–methoxy benzaldehyde, β-cadinene, carene, m – anisaldehyde, quinazoline – 4 – phenyl – 3 – oxide[8,9,10,11,12]

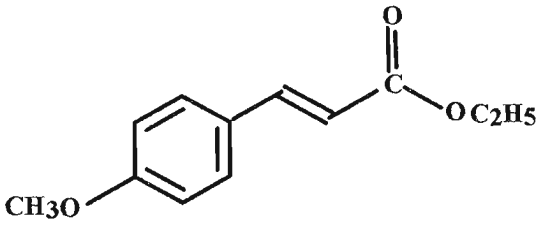
Root contains, camphene, 1,8 cineol, camphor, borneol, cinnamaldehyde, ethyl cinnamate, quinozoline, ethyl p-methoxy cinnamate, quinazoline–4–phenyl–3–oxide [9,10].

PHARMACOLOGY

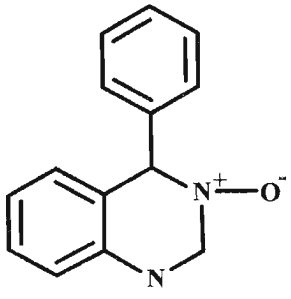
Essential oil from the root induced glutathione – s – transferase induction activities in stomach, liver and small intestine of mouse[14].
Ethanol extract of dried rhizome given to Guinea – pigs, showed an antispasmodic activity vs histamine - induced contraction and barium induced contraction[15].
An ethanol – water (1:1) extract indicated smooth muscle stimulant activity[6].
The water extracts of dried rhizome exhibited antitumour activity[16].
Rhizome and root oils of this plant showed antibacterial activity against *Escherichia coli, Staphylococcus aureus* and antifungal activity against *Cladosporium sp*[6,13,20].
Nematocidal activity was observed in rhizome of *K. galanga*[7].
Methanolic extract *K. galanga* rhizome showed larvicidal activity against second stage larva of dog round worm[17].
The rhizome oil showed toxicity against neonate larvae of *Spodoptera littoralis* and the oil is reported to possess insecticidal activity[18].
The hypolepidemic action of the ethanolic extraction of *K. galanga* was observed in vivo. The oral administration of the extract (20mg/day) of *K. galanga* effectively lowered the total cholesterol, triglycerides and phospholipid levels in serum and tissues and significantly increased the high-density lipoproteins levels in serum in high cholesterol fed white Wister rats over a period of 4 weeks. The results indicate the use of this plant in various lipid disorders especially atherosclerosis[19].



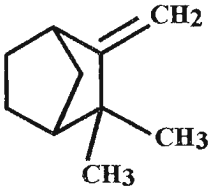
Ethyl cinnamate



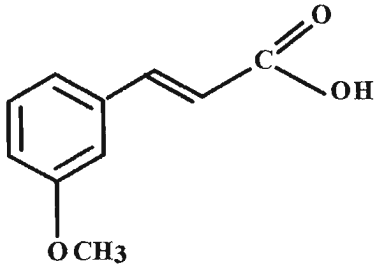
Ethyl p-methoxy cinnamate



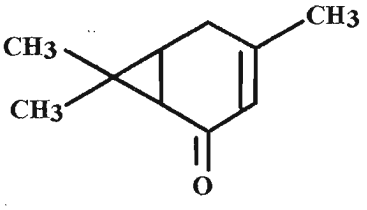
Quinazoline-4-phenyl-3-oxide



Camphene

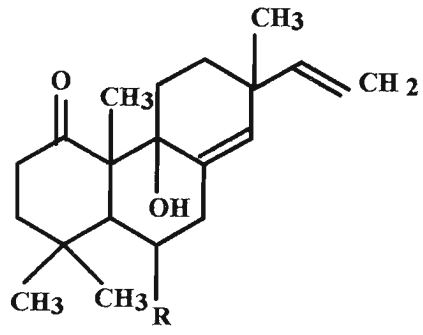


p-Methoxy cinnamic acid



Car-3-en-5-one

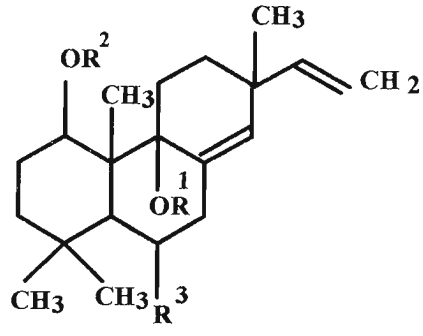
Fig 6 Main compounds in *Kaempferia galanga*



1. R = H Sandaracopimaradien -9-ol-1-one

2. R = OAc 6-Acetoxy Sandaracopimaradien -9-ol-1-one

3. R = OH Sandaracopimaradien 6 -9-diol-1-one



$R^1 = H$, $R^2 = H$, $R^3 = H$ Sandaracopimaradien -1,9-diol

$R^1 = H$, $R^2 = H$, $R^3 = OAc$ Acetoxy sandaracopimaradien -1,9-diol

$R^1 = H$, $R^2 = H$, $R^3 = OH$ Sandaracopimaradien -1,6,9-triol

Fig 7 Main compounds in *Kaempferia galanga*

GLC – PROFILE

A Shimadzu GC – 8A gas chromatograph equipped with a FID and a 3.0m x 3.0mm i.d. 10% Carbowax 20M packed column was employed.

Operating conditions

Initial oven temperature	-	70 ^{0}C
Final oven temperature	-	230 ^{0}C
Programmed rate	-	5^{0}C/min
Injector temperature	-	250 ^{0}C
Detector temperature	-	250 ^{0}C
Carrier gas	-	Argon
Argon; flow rate	-	30ml/min
Hydrogen; flow rate	-	25ml/min
Air flow rate	-	30ml/min
Sample size	-	0.1µl
Attenuation	-	6.0a.u.f.s.
Chart speed	-	5mm/min

Peak areas were obtained with a Shimadzu C – R6A chromatopac data processor and were used directly for indication of the relative amounts of individual components.

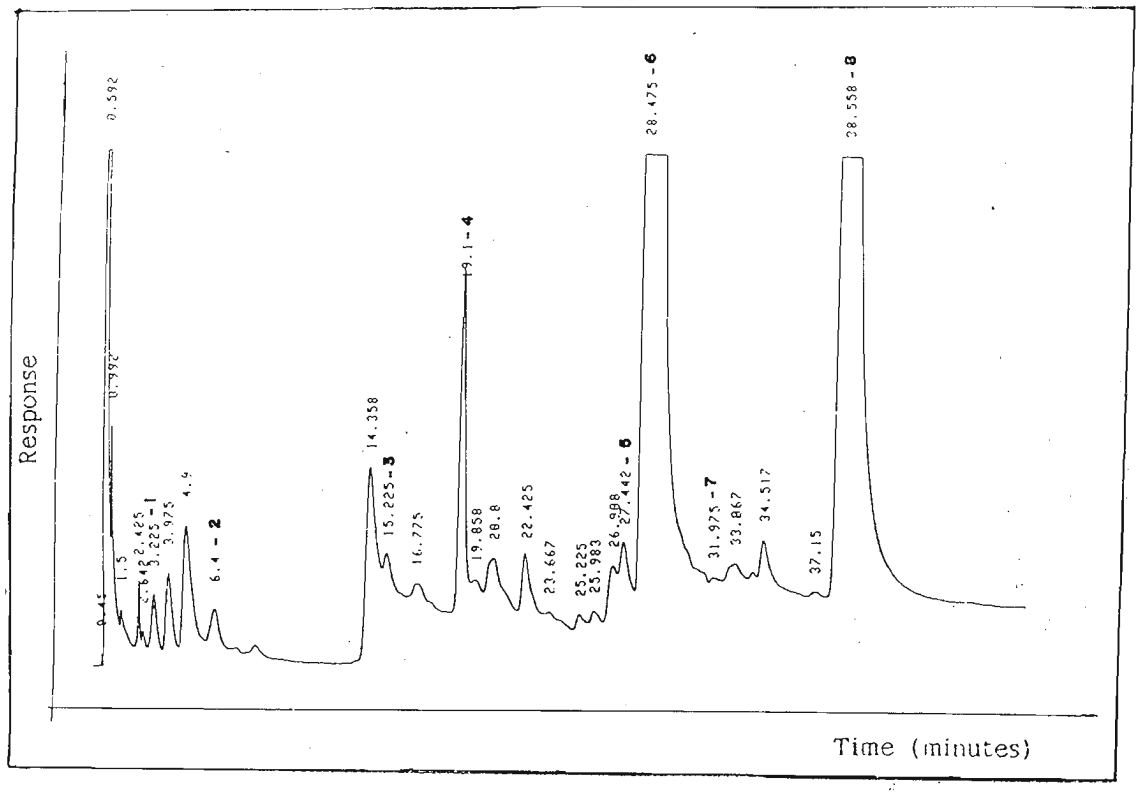


Fig - 8

GLC chromatogram of rhizome of *K. galanga*

Table – 2 Description of the GLC chromatogram of rhizome of *K. galanga*

Peak No	Rt (min)	Compound
1	3.22	Camphene
2	6.4	Cineol
3	15.22	Camphor
4	19.1	Borneol
5	27.44	Cinnamaldehyde
6	28.47	Ethyl cinnamate
7	31.97	Quinozoline
8	38.55	Ethyl p-methoxycinnamate

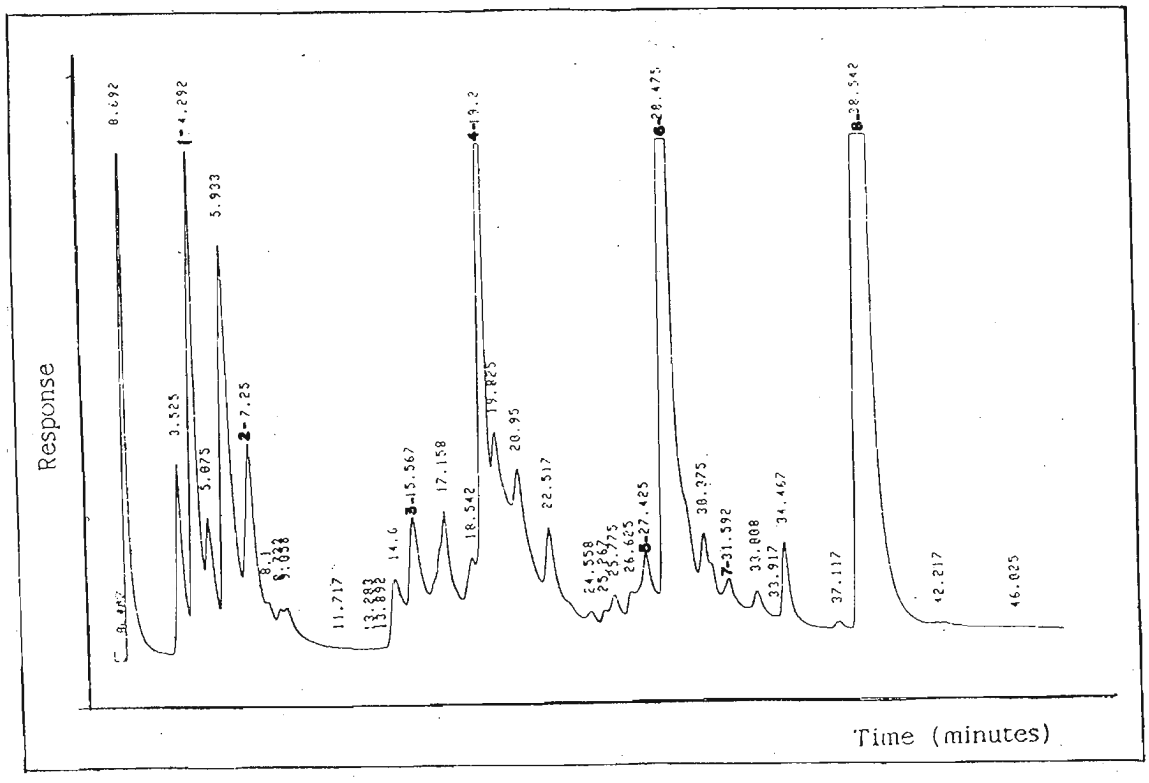


Fig - 9

GLC chromatogram of root of *K. galanga*

Table – 3 Description of the GLC chromatogram of root of *K. galanga*

Peak No	Rt (min)	Compound
1	4.29	Camphene
2	7.25	1,8 Cineol
3	15.56	Camphor
4	19.2	Borneol
5	27.42	Cinnamaldehyde
6	28.47	Ethyl cinnamate
7	31.59	Quinozoline
8	38.54	Ethyl p-methoxycinnamate

TLC PROFILE

Sample preparation

Sample detail	-	*K. galanga* rhizome
Sample preparation	–	*K. galanga* rhizome (5.0g) was extracted with ethanol and concentrated (12.3 mg/10ml) 15 µl of extract was applied to TLC plate.
Adsorbent	-	Silica gel GF_{254}
Solvent system	–	Chloroform : toluene (9:1)

Detection

Direct evaluation	-	UV_{254}nm UV_{366}nm Rf values (UV_{254}) = 0.820, 0.731 Rf values (UV_{366}) = 0.731
Scanning	-	Densitometer
Spray reagent	-	Methanol and sulphuric acid

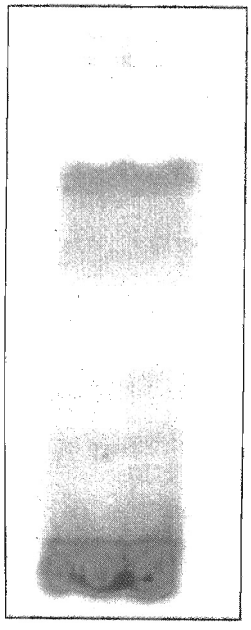


Fig – 10

TLC chromatogram of
K. galanga rhizome extract

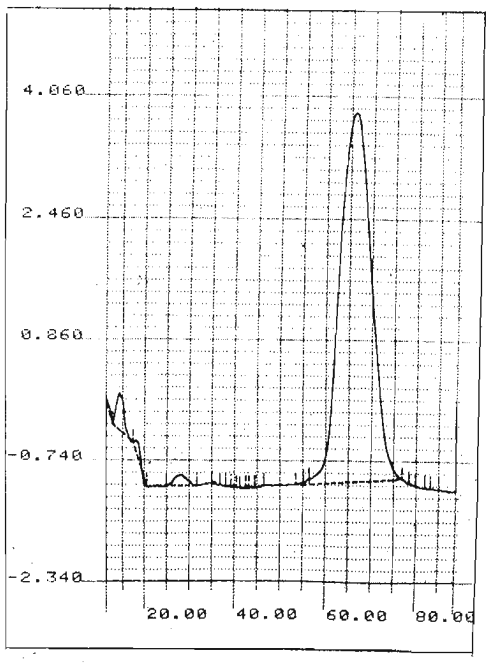


Fig - 11

TLC Densitometer finger print

TLC PROFILE

Sample preparation

Sample detail	-	*K. galanga* root
Sample preparation	-	*K. galanga* root (5.0g) was extracted with ethanol and concentrated (12.3mg/10ml) 15 µl of extract was applied to TLC plate.
Adsorbent	-	Silica gel G F_{254}
Solvent system	–	Chloroform : toluene (7:3)

Detection

Direct evaluation	-	UV_{254}nm UV_{366}nm Rf values (UV_{254}) = 0.787, 0.55 Rf values (UV_{366}) = 0.512
Scanning	-	Densitometer
Spray reagent	-	Vanillin - sulphuric acid

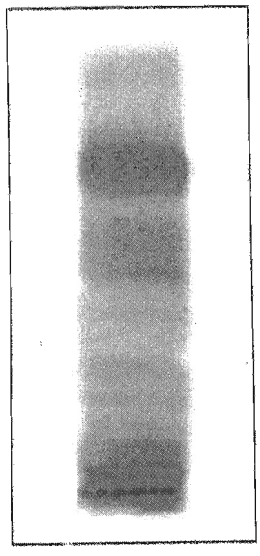


Fig – 12
TLC chromatogram of *K. galanga* root extract

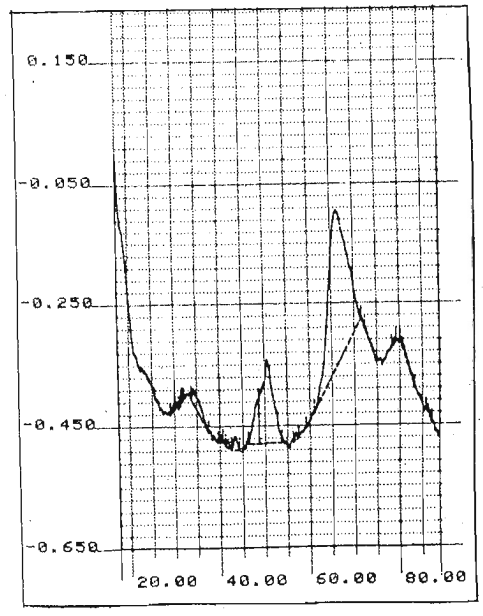


Fig - 13
TLC Densitometer finger print

HPLC PROFILE

K. galanga rhizome,

Sample preparation	-	*K. galanga* rhizome (5.0g) was extracted with ethanol (2.74mg/10ml) and purified using Sep-pak C18 cartridge.
Injection volume	-	20µl
Apparatus	-	Waters 501 HPLC pump. SPD 10AV Shimadzu uv-vis detector.
Column	-	µ Bondapak™ RP18
Solvent system	-	Methanol : water (1: 1)
Flow rate	-	1ml/min
Detection	-	254nm

Description of the HPLC – Chromatogram

Table - 4

Retention time of main peaks

Peak no	Rt (min)
1	0.138
2	1.198
3	1.667
4	2.442
5	7.418
6	17.075
7	21.023
8	24.61

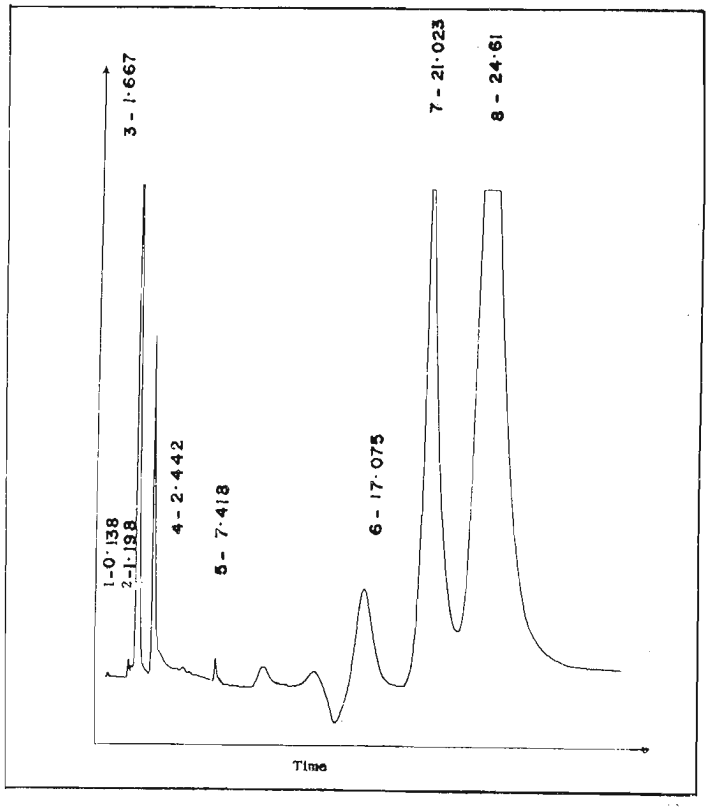


Fig – 14

HPLC chromatogram of rhizome

HPLC PROFILE

K. galanga root,

Sample preparation - *K. galanga* root (5.0g) was extracted with ethanol (12.3mg/10ml) and purified using Sep-pak C18 cartridge.

Injection volume - 20µl

Apparatus - Waters 501 HPLC pump. SPD 10AV Shimadzu uv-vis detector.

Column - µ Bondapak™ Reverse phase column.

Solvent system - Methanol : water (1 : 1)

Flow rate - 1ml/min

Detection - 254nm

Description of the HPLC – Chromatogram

Table - 5

Retention time of main peaks

Peak no	Rt (min)
1	0.665
2	1.167
3	1.383
4	1.752
5	2.015
6	2.145
7	2.448
8	3.07
9	3.525
10	4.418
11	7.408
12	20.623

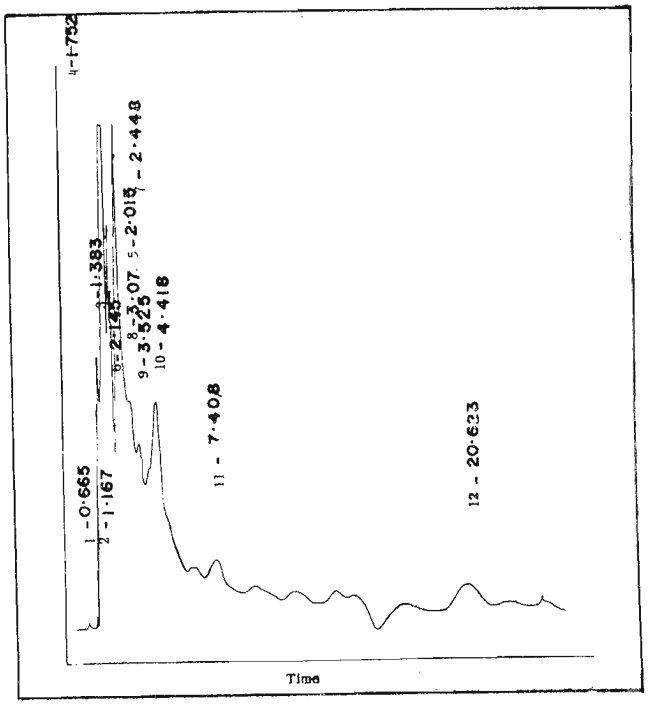


Fig – 15

HPLC chromatogram of root

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