'SOPHISTICATION OF FINGERPRINTING METHODS FOR POLYHERBAL TRADITIONAL MEDICINES FROM 'MERE QUALITY' TO 'QUALITY PLUS COMPOSITION'

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QUALITY CONTROL AND STANDARDIZATION OF HM

- No effective machinery to regulate manufacturing practices and quality standards.
- Can buy herbal products without a prescription and might not recognize inferior product.
- A well-defined and constant composition of the drug is one of the prerequisites for the production of a quality drug.
- Composition of Natural products are not constant and are dependent and influenced by many factors.

THE NEED FOR STANDARDIZATION

- No official standards are available for many herbal preparations.
- Those manufacturers, who are currently doing some testing for their formulations, have their own preliminary testing parameters.
- It is very difficult to identify the presences of all the ingredients as claimed in a formulation.
- It is important to evolve such parameter by which the presence of the entire ingredient can be identified.
- Evaluation of physicochemical properties in combination with various chromatographic and spectrophotometric methods and can be tried to evolve pattern for identifying the presence of different ingredient.

PROCEDURES FOR STANDARDIZATION AND QUALITY CONTROL OF HM

- Micro-microscopic evaluation
- Analytical methods
  - Physico-chemical evaluation
  - Chromatography
- Biological evaluation

CHROMATOGRAPHY

- TLC, HPLC, GC, and HPTLC can determine the similarities and differences of a plant extract.
- These techniques hyphenated with spectroscopic techniques like MS (GC-MS and LC-MS) and NMR are powerful tools used for standardization and to quality control.
- These sophisticated techniques provide a chemical fingerprint as to the nature of chemicals or impurities present in the plant or extract.

POLYHERBAL FORMULATIONS (PHF)

- "*Sarangdhar Samhita*" 1300 A. D. has highlighted the concept of PHF
- Plants of varying potency when combined may theoretically produce a greater result, compared to individual use of the plant and also the sum of their individual effect.
- Positive herb-herb interaction (synergism) is believed to be important.
- Combination of herbals may act on multiple targets at the same time to provide a thorough relief

RATIONALE OF POLY-HERBAL FORMULATION IN AYURVEDA

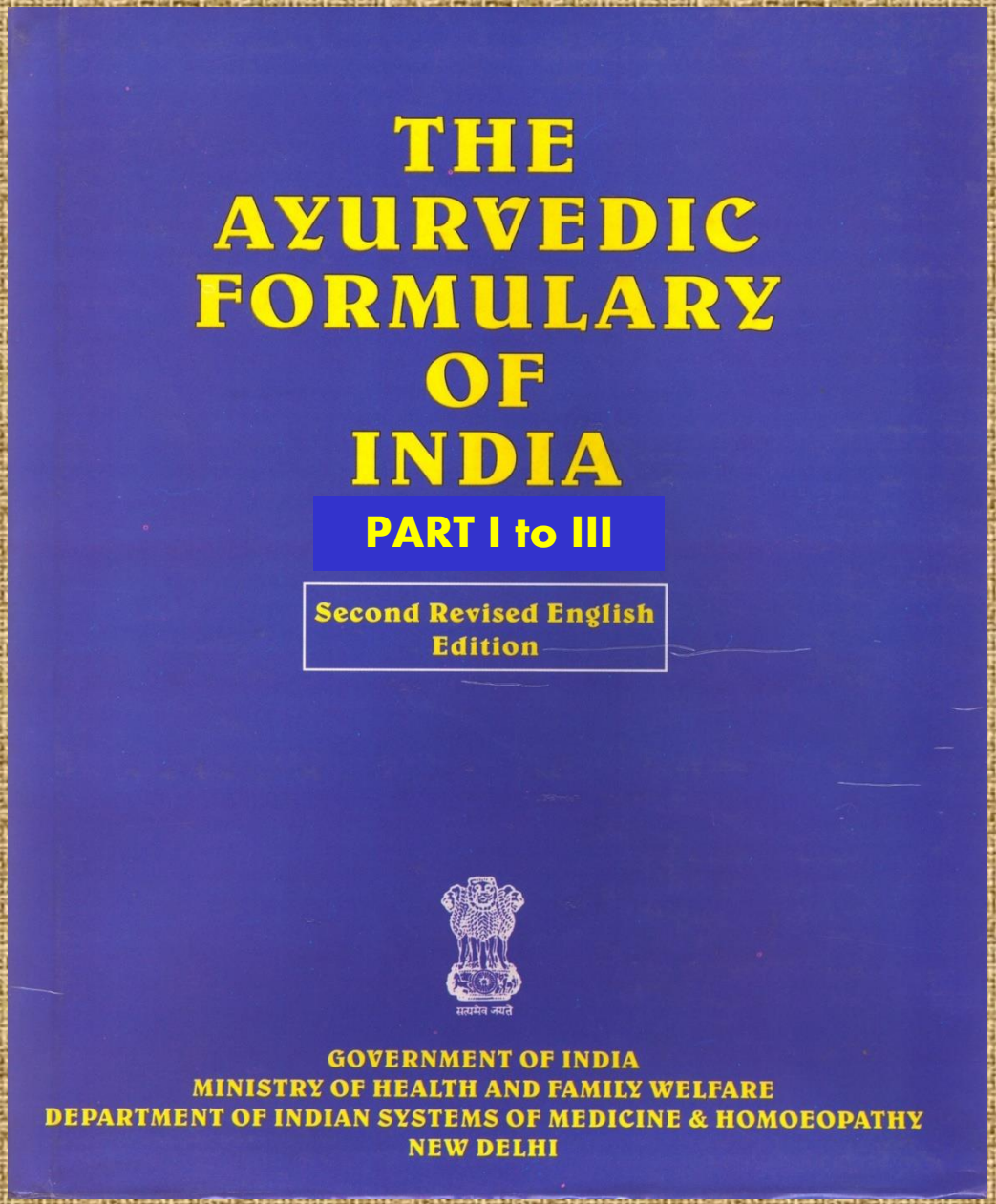
1. Molecules follow specific pathway and act on specific receptor.

2. In a Disease condition, multiple organ systems are involved, therefore, drug should have a multiple targeted action.

3. Internal chemical involvement significantly varies from person to person.

5. Combination of different herbs targets different sites of action.

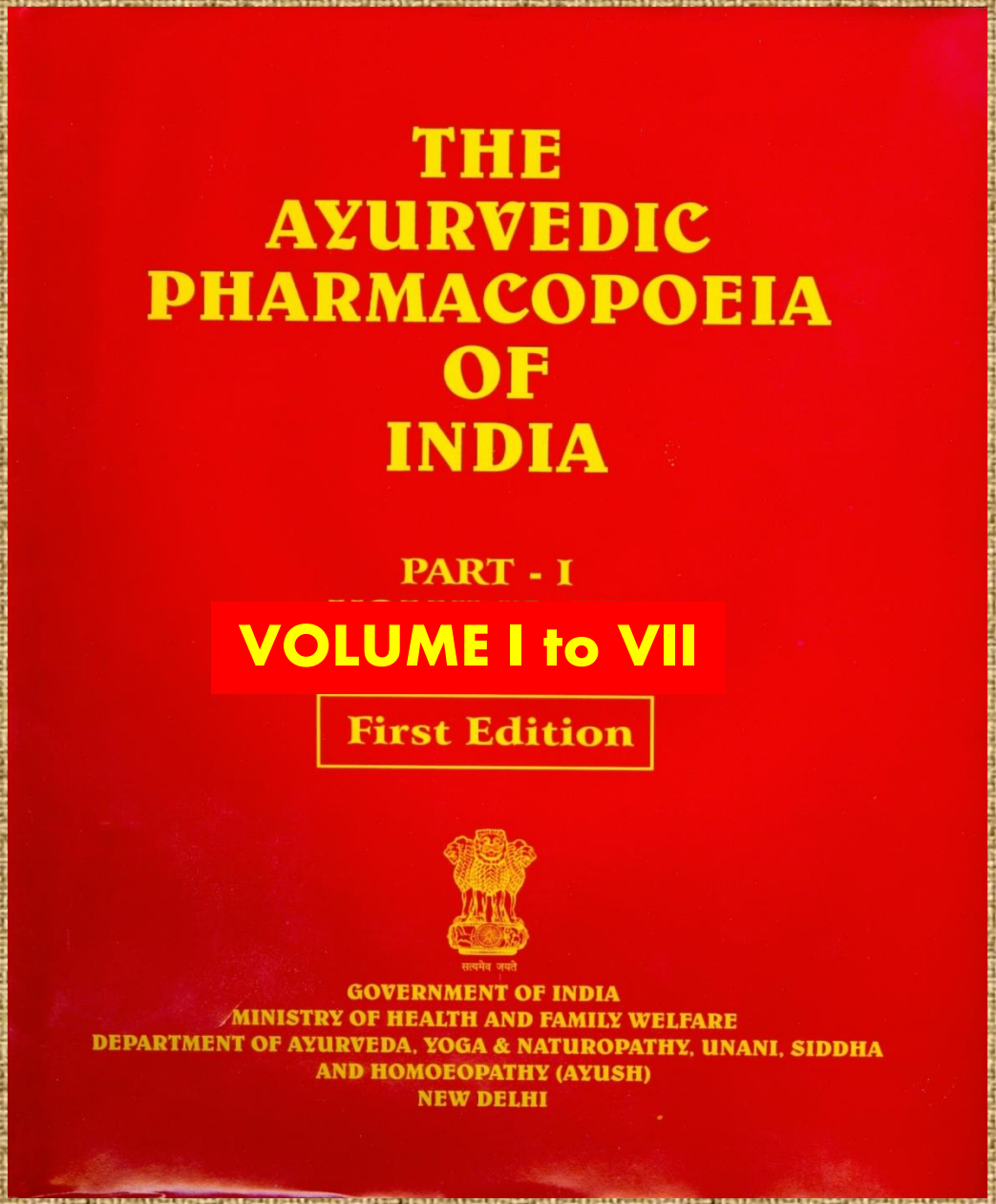
THE AYURVEDIC FORMULARY OF INDIA (AFI)



FORMULATIONS IN AFI

	Part I	Part II	Part III	Total
Asava and Arishtas	37	3	17	57
Arka	4	2	14	20
Avaleha and Paka	32	7	20	59
Kvatha churna	33	25	30	88
Guggulu	12	2	7	21
Ghrita	44	4	-	48
Churna	40	19	69	128
Taila	62	18	26	106
Dravaka	1	-	-	1
Lavana kshara	13	-	2	15
Lepa	12	5	23	40
Vati and Gutika	35	14	26	75

THE AYURVEDIC PHARMACOPOEIA OF INDIA (API Part I)



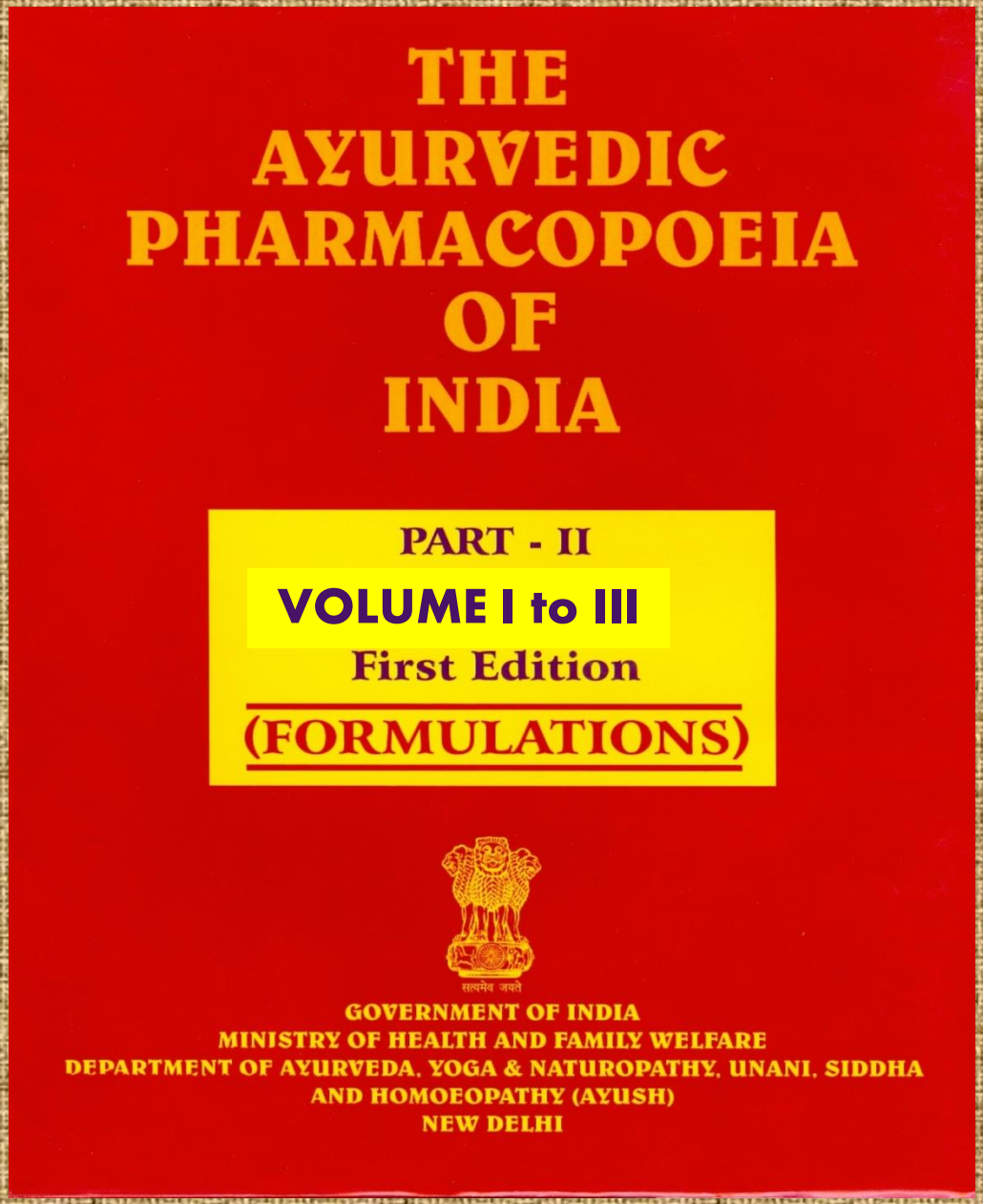
QUALITY STANDARDS OF DRUGS
AYURVEDIC PHARMACOPOEIA OF INDIA

- **Ayurvedic Pharmacopoeia Committee (APC), notified by the Government approves the pharmacopoeial standards.**

- **Scientific Institutions / Research Institute / laboratories undertake basic work of standardization.**

- **Experts of Ayurveda, phytochemistry, pharmaceutical sciences, pharmacognosy, inorganic chemistry, geochemistry and medicinal plants are associated for evaluation of Pharmacopoeial monographs.**

THE AYURVEDIC PHARMACOPOEIA OF INDIA (API Part II)



PHARMACOPOEIAL STANDARDS OF MULTIPLE INGREDIENT AYURVEDIC FORMULATIONS

1. To develop SOP's of manufacturing process of formulation
2. To develop standards of identity, purity and strength of ingredients & compound formulation
3. Pharmacognostic & chemical standardization Shelf life studies
4. Many Laboratories & manufacturing companies are working on SOP's
5. Pharmacopoeial Standards of 101 formulation have been published.
6. Annual Target is 50 formulations per year to cover 500 most widely used formulations.

QUALITY STANDARDIZED FORMULATIONS IN API PART II

	Vol I	Vol II	Vol III	Total
Asava and Arishtas	24	-	-	24
Arka	-	-	12	12
Avaleha	12	4	3	19
Kvatha churna				
Guggulu	1	13	3	17
Ghrita	12	4	1	17
Churna	11	4	1	16
Taila	6	1	20	27
Lepa	1	-	-	1
Gutika	1	-	-	1
Vati	-	-	11	11
Kshara/ Lauha	6	-	-	6
Kshara sutra	1	-	-	1

Contd....

Varti, Netrabindu and Anjana	8	2	2	12
Sattva	1	-	-	1
Pisti	4	2	1	7
Bhasma	22	5	-	27
Mandura	2	3	4	9
Rasayoga	55	69	96	220
Lauha	12	9	11	32
Dhupa	-	-	1	1

EXAMPLE 1: ANALYSIS OF CHATURJATA CHURNA AFI, PART-I, P.108

Formulation composition:

Tvak	*Cinnamomum zeylanicum*	Stem Bark	1 part
Elā (Sūkṣmailā)	*Elettaria cardamomum*	Seed	1 part
Patra (Tvak patra)	*Cinnamomum tamala*	Leaf	1 part
Kesara (Nagakesara)	*Mesua ferrea*	Stamen	1 part

Imprtnat therapeutic uses: Arocaka (tastelessness), Kaphaja roga, Viṣa (poison) and Vaivarṇya.

- **The study was supported by UGC Major Research Project (F. No. 41-733/2012 (SR) dated 23rd July, 2012.**

MACROSCOPY OF RAW DRUGS



Fig. 1.1 Tvak
(*Cinnamomum verum*)



Fig 1.2 Elā – Fruit
(*Elāttaria cardamomum*)



Fig 1.3 Elā - Seed
(*Elāttaria cardamomum*)



Fig 1.5.1 Tvak patra
(*Cinnamomum tamala*)



Fig 1.5.2 Nagakesara
Mesua ferrea

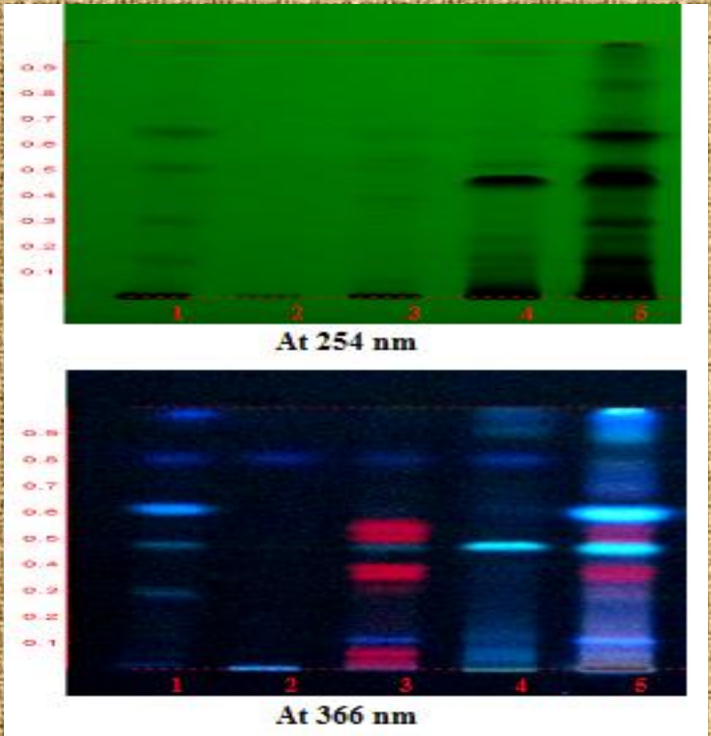


Fig 1.6 Nagakesara
substitute *Mammea suriga*

PHYSICO CHEMICAL PARAMETERS OF CATURJATA CŪRṆA PREPARED USING *MESUA FERREA* (MF) AND *MAMMEA SURIGA* (MS)

Parameters (%w/w)	Caturjata Cūr?a with *M. ferrea*	Caturjata Cūr?a with *M. suriga*	Deviation
Loss on drying at 105°	10.39	10.60	+ 0.21
Total ash	4.1	5.59	+ 1.49
Acid-insoluble ash	0.90	1.20	+ 0.30
Alcohol -soluble extractive	10.0	7.15	- 2.85
Water-soluble extractive	8.77	9.75	+ 0.98
*p*H	4.58	4.42	- 0.16

TLC PHOTO DOCUMENTATION OF CHLOROFORM EXTRACT OF INGREDIENTS WITH CATURJĀTA CŪRNA (4 µL)

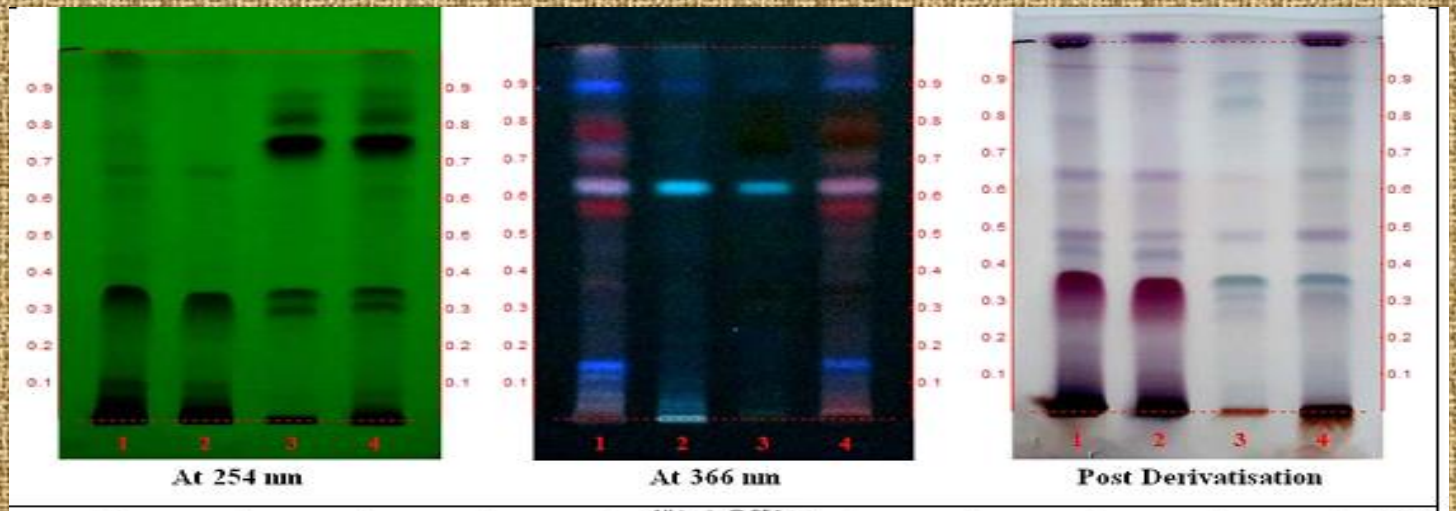


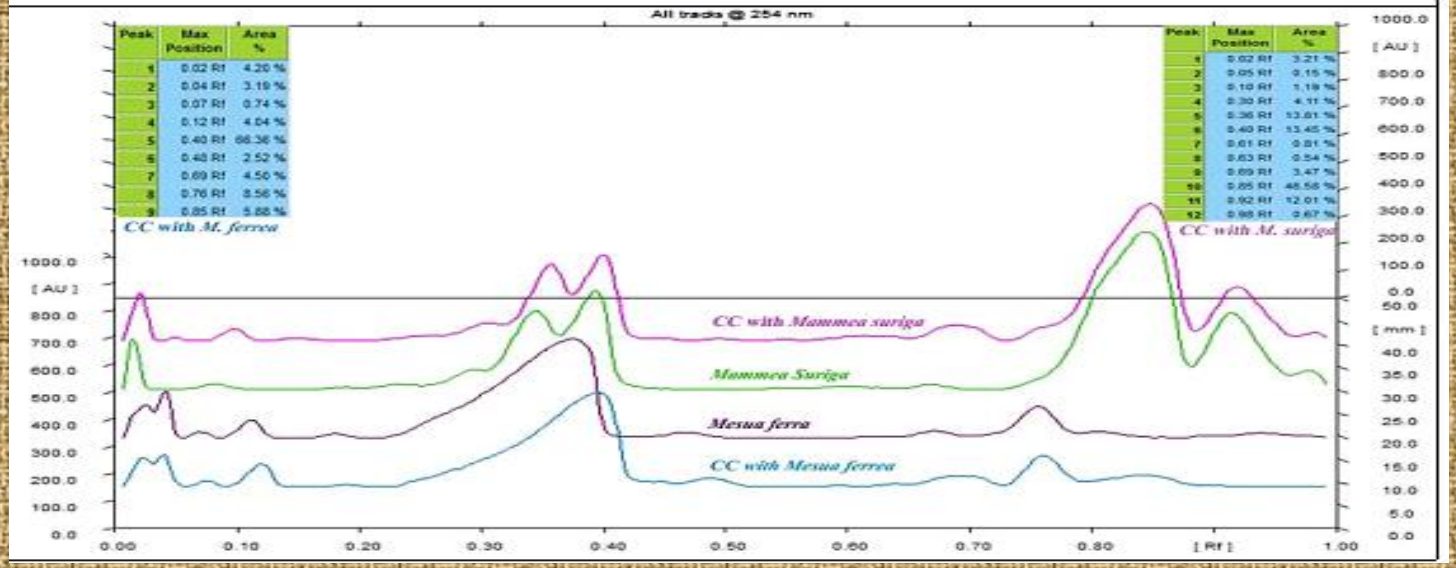


Solvent system: Toluene: Ethyl acetate: Formic acid (4.5: 0.5: 0.1)

Track 1 - Tvak (*Cinnamomum verum*); 2 - Elā (*Elettaria cardamomum*); 3 - Tvak Patra (*Cinnamomum tamala*); 4 - Nagakesara (*Mesua ferrea*); 5 - Caturjata Curna

TLC PHOTO DOCUMENTATION OF CATURJĀTA CŪRNA FORMULATION WITH NAGAKESARA – *MESUA FERREA* AND *MAMMEA SURIGA*





EXAMPLE 2: ANALYSIS OF BHUNIMBADI KVATHA CHURNA
AFI, PART-III, P.73

Imprtnat therapeutic uses: Asthama, cough, fever due to pitta dosa, bleeding disorder, fever .

- **The study was supported by VGST SMYSR Project (No. VGST/P-3/SMYSR/GRD-291/2013-14 dtd. 24 FEB 2014).**

Formulation composition:

Bhūnimba	*Swertia chirata*	Pl.	1 part
Ativiṣā	*Aconitum heterophyllum*	Rt.	1 part
Lodhra	*Symplocos racemosa*	St. Bk.	1 part
Mustaka (Musta)	*Cyperus rotundus*	Rz.	1 part
Indrayava	*Holarrhena antidysenterica*	Sd.	1 part
Bālaka (Hrivera)	*Coleus vettiveroides*	Rt.	1 part
Dhānyaka	*Coriandrum sativum*	Fr.	1 part
Bilva	*Aegle marmelos*	Fr. Pp.	1 part

MACROSCOPY OF INGREDIENTS OF BHŪNIMBĀDI KVĀTHA CŪRṇA



Fig. 1.1 Bhūnimba – Whole Plant



Fig. 1.2 Ativi?ā - Tuber



Fig. 1.3 Lodhra - Bark



Fig. 1.4 Mustaka – Rhizome



Fig. 1.5 Indrayava - Seed



Fig. 1.6 Bālaka – Root



Fig. 1.7 Dhānyaka - Fruit



Fig. 1.8 Bilva – Pulp

PHYSICO-CHEMICAL CONSTANTS OF RAW MATERIALS USED FOR THE PREPARATION OF BHŪNIMBĀDI KVĀTHA CŪRNA

Name of the Ingredient	Results expressed as % w/w (n=3) Mean ± SD						
	LOD	TA	AIA	ASE	WSE	HASE	pH
Bhūnimba	12.21 ± 0.03	3.75 ± 0.08	0.75 ± 0.06	6.22 ± 0.38	9.94 ± 0.20	10.99 ± 0.74	5.93 ± 0.06
Ativi?ā	11.59 ± 0.14	2.44 ± 0.07	0.15 ± 0.07	1.94 ± 0.03	14.97 ± 1.01	18.24 ± 0.02	5.85 ± 0.05
Lodhra	9.79 ± 0.19	12.17 ± 0.01	0.95 ± 0.06	7.705 ± 0.22	24.66 ± 0.28	22.80 ± 0.06	5.10 ± 0.02
Mustaka	11.35 ± 0.02	6.94 ± 0.07	3.60 ± 0.14	1.74 ± 0.02	7.40 ± 0.42	7.34 ± 0.14	5.15 ± 0.01
Indrayava	7.52 ± 0.03	5.58 ± 0.10	0.495 ± 0.01	23.90 ± 0.40	21.47 ± 0.58	14.43 ± 0.32	4.65 ± 0.05
Bālaka	15.35 ± 0.32	10.84 ± 0.08	0.996 ± 0	4..33 ± 0.10	8.84 ± 0.03	6.65 ± 0.57	5.88 ± 0.04
Dhānyaka	8.20 ± 0.09	6.10 ± 0	0.65 ± 0.07	8.68 ± 0.27	11.85 ± 0.22	9.80 ± 0.16	4.94 ± 0.08
Bilva	14.69 ± 0.14	9.96 ± 0.1	0.30 ± 0	8.69 ± 0.02	52.87 ± 0.76	49.69 ± 0.22	6.04 ± 0.04

LOD – Loss on drying at 105º; FM - Foreign matter; TA - Total ash; AIA – Acid Insoluble ash; ASE – Alcohol soluble extractive; WSE – Water soluble extractive;

HASE – Hydro alcohol soluble extractive

POWDER MICROSCOPY OF INGREDIENTS OF BHŪNIMBĀDI KVĀTHA CŪRNA



Fig. 2.1 Bhūnimba

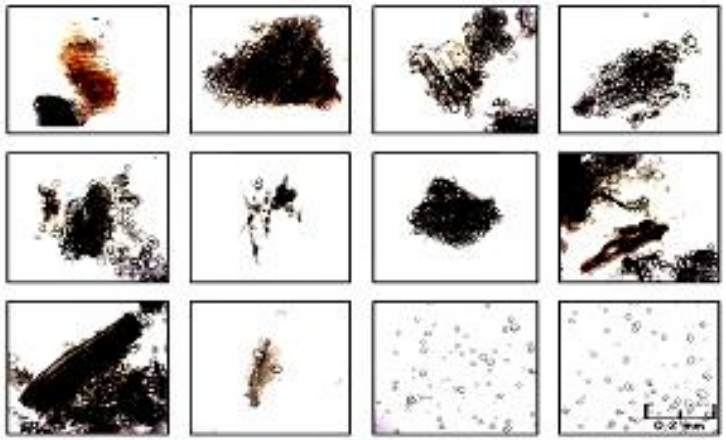


Fig. 2.2 Ativi?ā

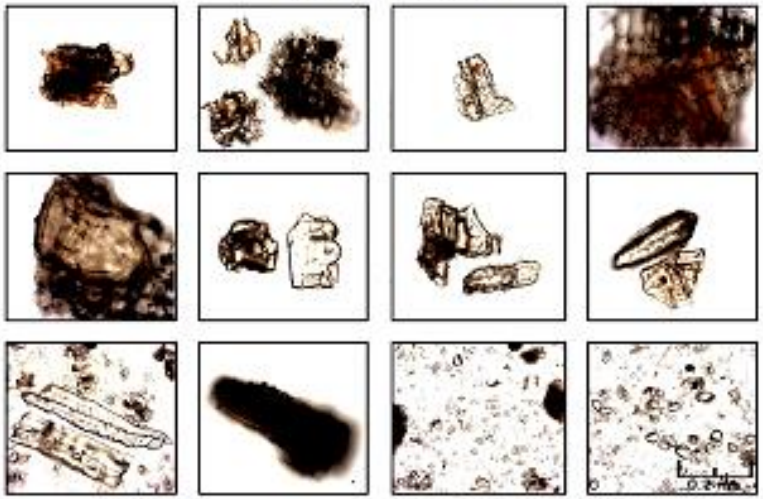


Fig. 2.3 Lodhra

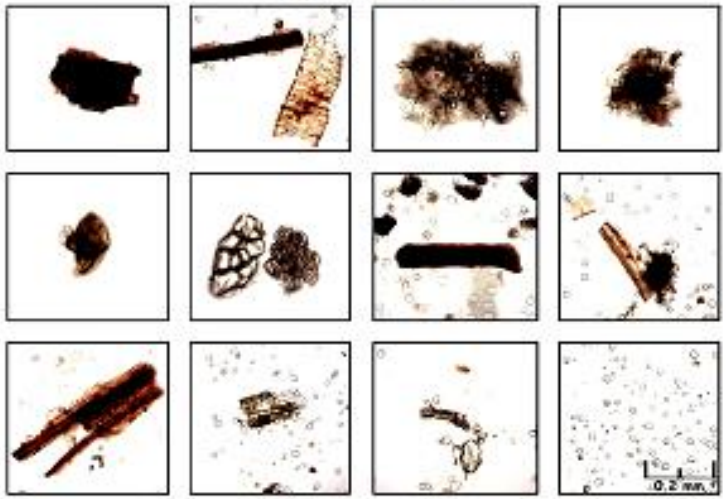


Fig. 2.4 Mustaka

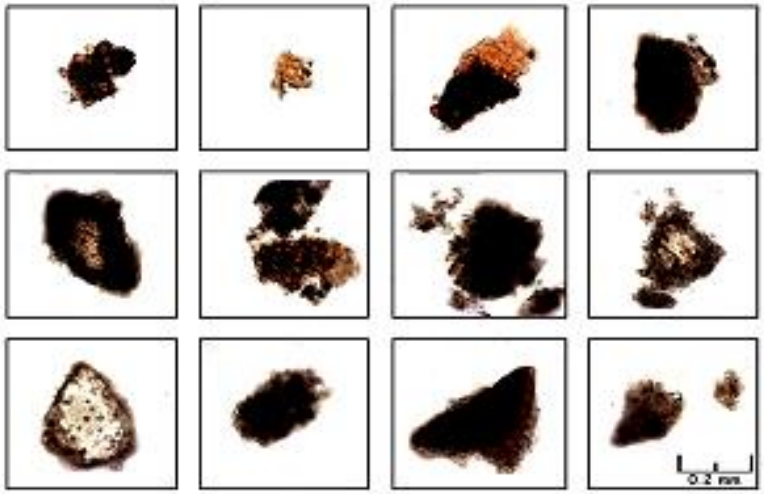


Fig. 2.5 Indrayava



Fig. 2.6 Bālaka

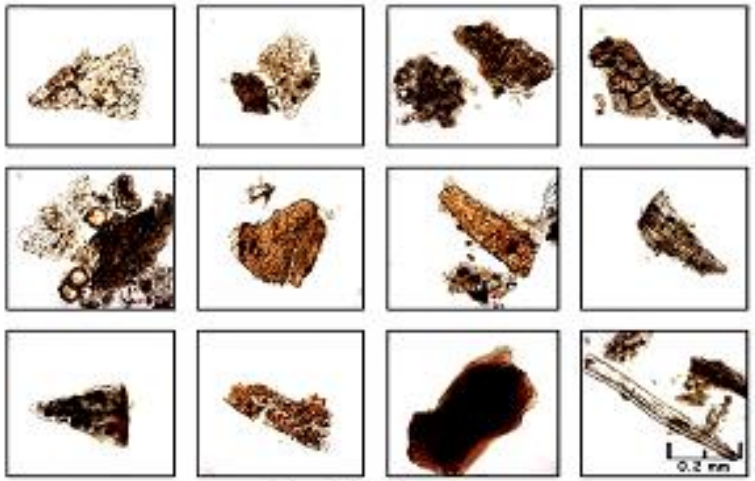


Fig. 2.7 Dhānyaka

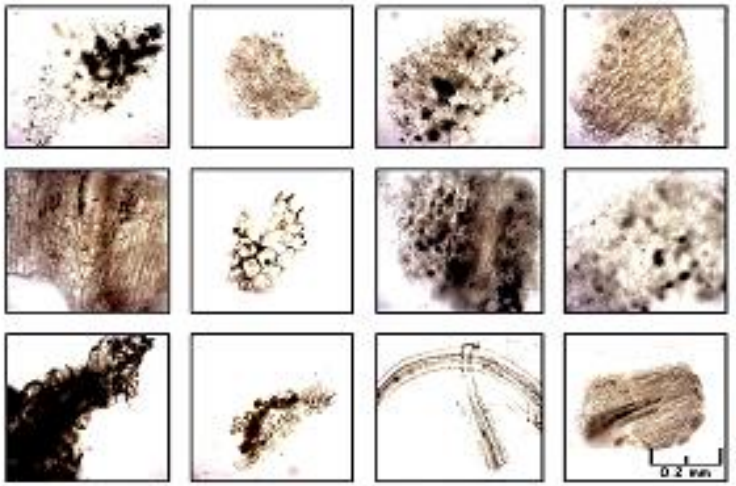


Fig. 2.8 Bilva

Microscopy of Bhūnimbādi Kvātha Cūr?a



Fig. 3.1 Bhūnimba



Fig. 3.2 Ativi?ā



Fig. 3.3 Lodhra



Fig. 3.4 Mustaka



Fig. 3.5 Indrayava



Fig. 3.6 Balaka



Fig. 3.7 Dhānyaka



Fig. 3.8 Bilva

TLC PHOTO DOCUMENTATION OF BHŪNIMBĀDI KVĀTHA CŪRṆA & ITS INGREDIENTS

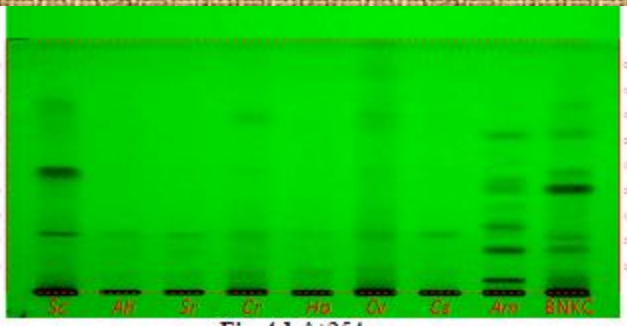


Fig. 4.1 At254 nm

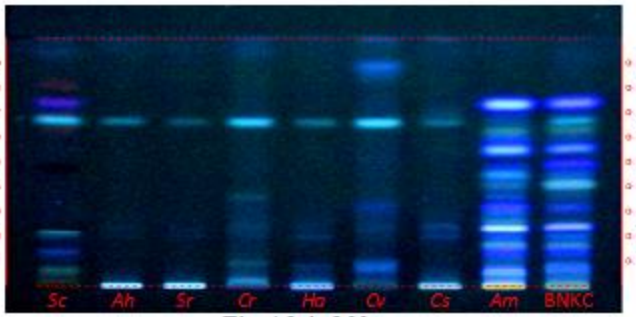


Fig. 4.2 At366 nm

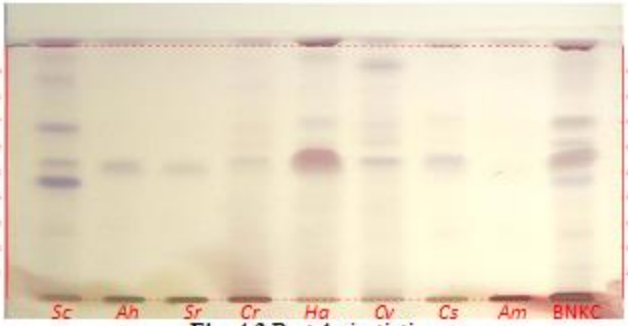


Fig. 4.3 Post derivatiation

Sc **– Kirātatikta (*Swertia chirata*) – 5 µl;**
Ah **– Ativiṣā (*Aconitum heterophyllum*) - 5 µl;**
Sr **– Lodhra (*Symplocos racemosa*) – 5 µl;**
Cr **– Mustaka (*Cyperus rotundus*) - 5 µl;**
Ha **– Indrayava (*Holarrhena antidysenterica*) – 5 µl;**
Cv **– Bālaka (*Coleus vettiveroides*) - 5 µl;**
Cs **– Dhānyaka (*Coriandrum sativum*) – 5 µl;**
Am **– Bilva (*Aegle marmelos*) - 5 µl;**
BKC – Bhūnimbādi Kvātha Cūrṇa – 15 µl
Toluene: Ethyl Acetate: Formic Acid
7: 2: 0.2

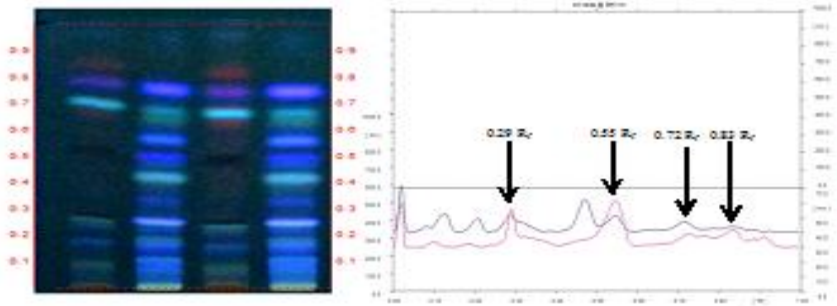


Figure 1a. Bhūnimba

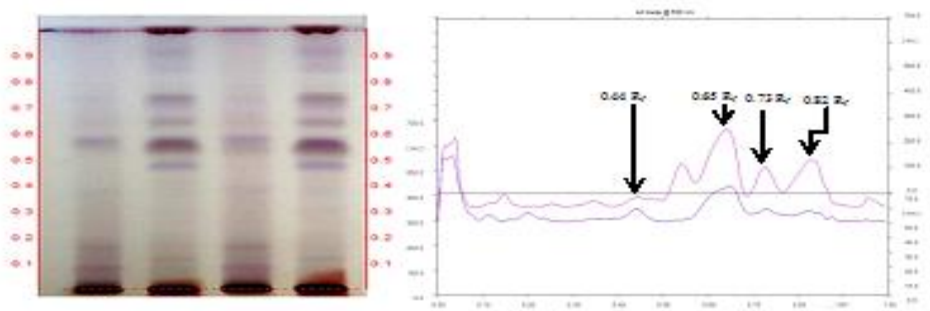


Figure 1b. Ativi?ā

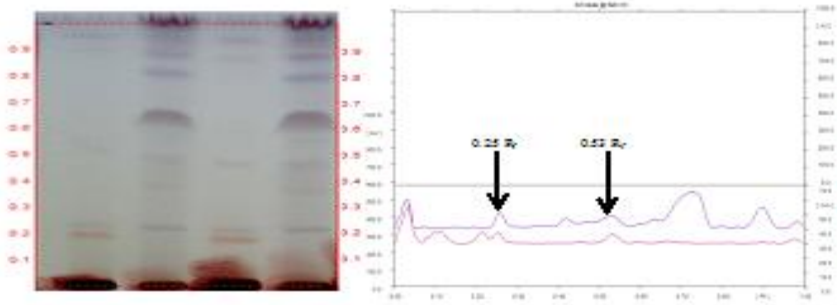


Figure 1c. Lodhra

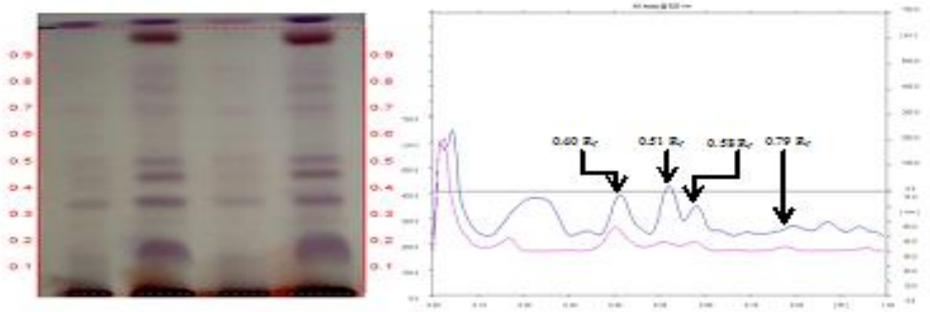


Figure 1d. Musthaka

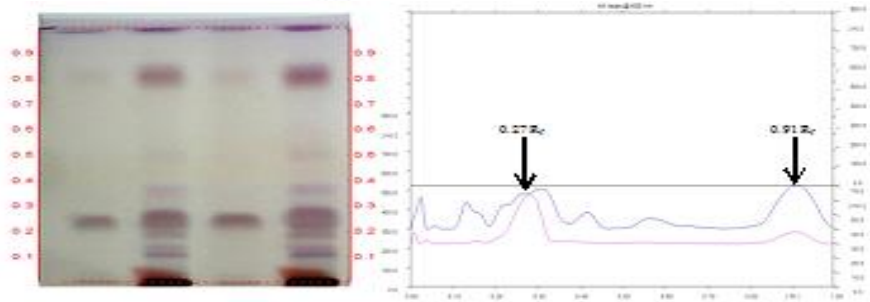


Figure 1e. Indrayava

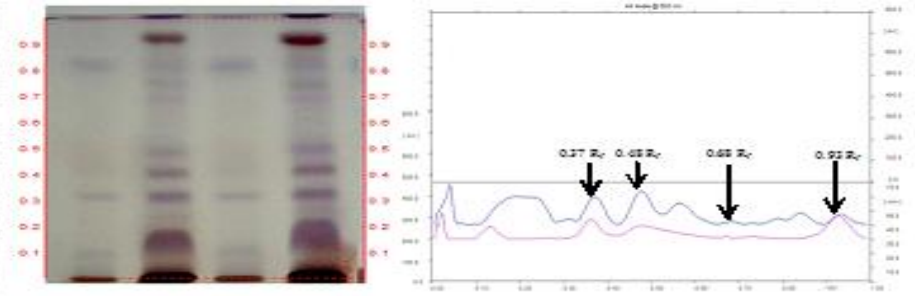


Figure 1f. Bālaka

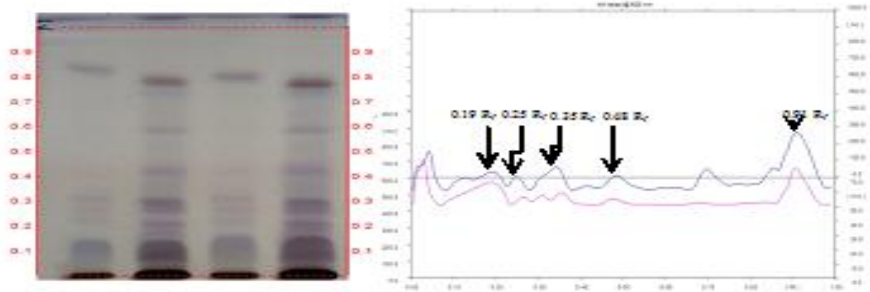


Figure 1g. Dhānyaka

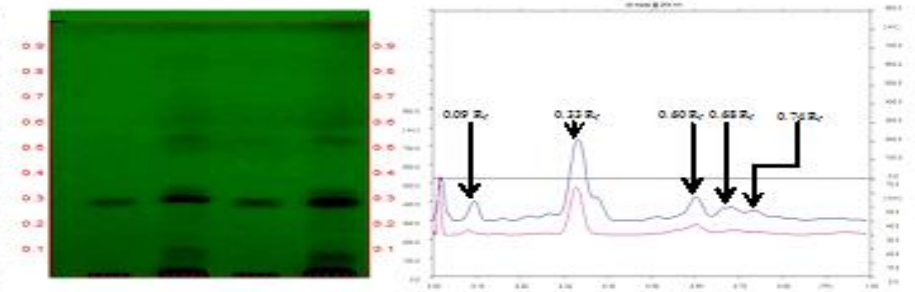
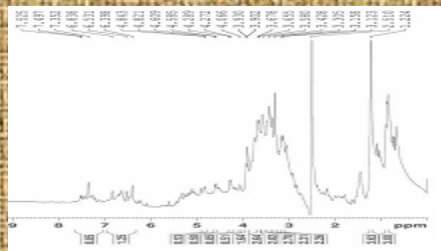


Figure 1h. Bilva

^{1}H NMR SPECTRUM OF BHŪNIMBADI KWATHA CHURNA AND ITS INGREDIENTS



e 2a. Bhūnimba

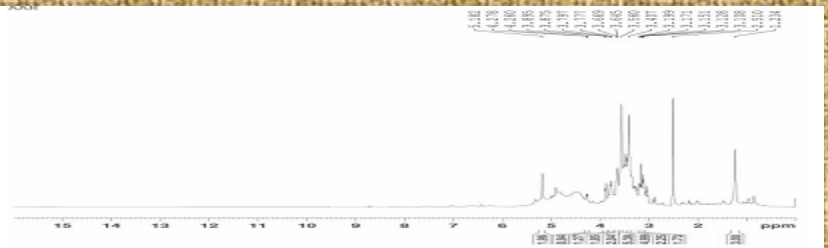
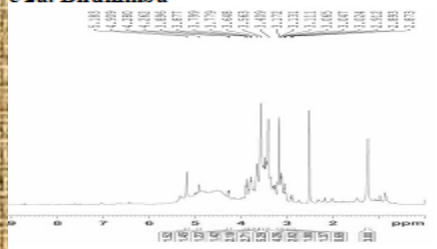


Figure 2b. Ativi?ā



ıre 2c. Lodhra

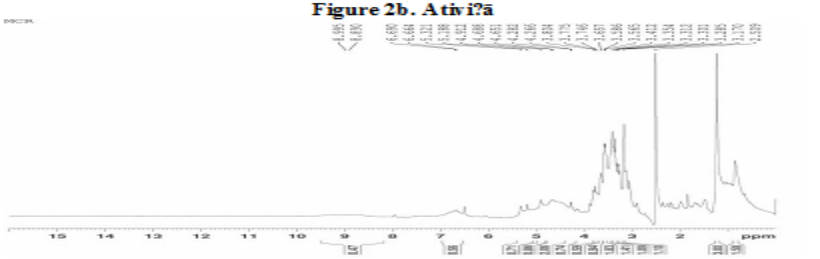
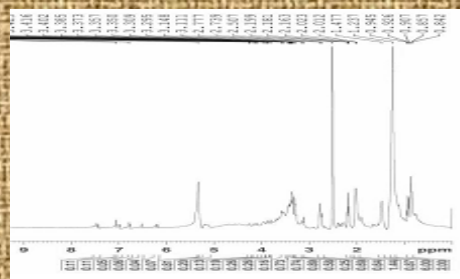


Figure 2d. Musthaka



re 2e. Indrayava

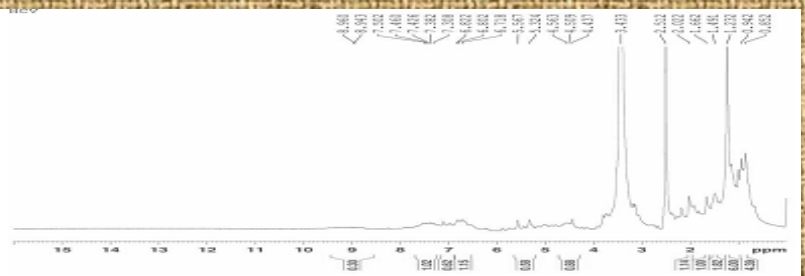
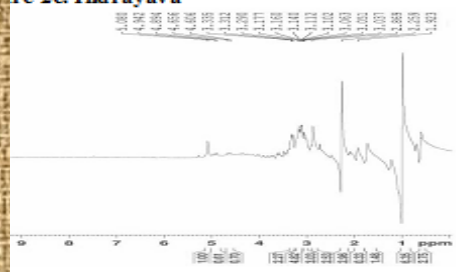


Figure 2f. Bālaka



re 2g. Dhānyaka

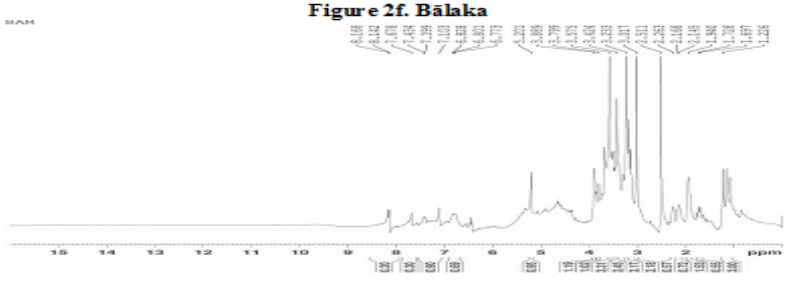


Figure 2h. Bilva

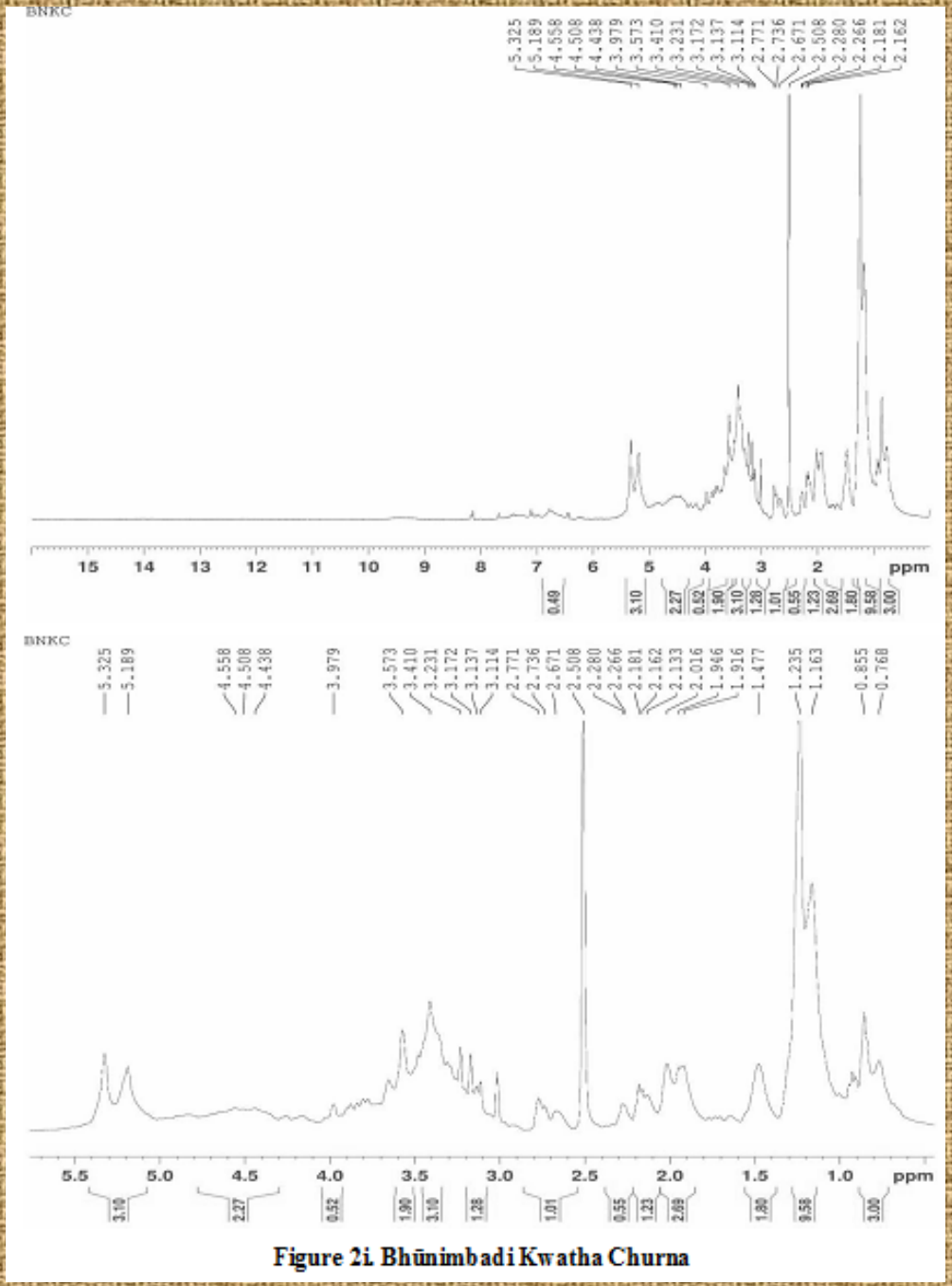


Figure 2i. Bhūnimbadi Kwatha Churna

EXAMPLE 3: JAMBUPALLAVADI KVATHA CHURNA (AFI, PART-III, P. 91)

Formulation composition:

Jambupallava	*Syzygium cumini*	leaf	1 part
Ambrapallava	*Mangifera indica*	leaf	1 part
Usira	*Vetiveria zizaniodies*	Root	1 part
Vata root	*Ficus benghalensis*	Aerial root	1 part
Asvattha root	*Ficus religiosa*	Aerial root	1 part

Important Therapeutic Uses: Chardi (emesis), pravahika (dysentery), meha (excessive flow of urine).

The study was supported by RGUHS Major Research Project No. RGU:R&D:Res.Wing:2014-15 dtd. 13 MAR 2015

MACROSCOPY OF THE 5 INGREDIENTS OF JKC

1. Jambupallava



2. Amrapallava



3. Ushira



4.Vata



5.Ashwattha



PHYSICO-CHEMICAL CONSTANTS OF RAW MATERIALS USED IN JKC

Name of the Ingredients	LOD	TA	AIA	ASE	WSE
Jambupallava	1.33	4.52	0.25	20.03	23.60
Amrapallava	7.38	8.26	0.70	9.63	16.68
Usheera	8.06	10.37	7.29	4.40	7.81
Vata	9.35	5.84	0.20	2.53	4.85
Asvattha	9.48	6.42	1.30	0.98	2.42

Results expressed as % w/w

LOD – Loss on drying at 105º; TA - Total ash; AIA – Acid Insoluble ash; ASE – Alcohol soluble extractive; WSE – Water soluble extractive.

ORGANOLEPTIC CHARACTERISTICS OF JKC

Parameters	JKC
Appearance	Course powder
Colour	Yellowish brown
Odour	Characteristic
Texture	Coarse
Taste	Characteristic

PHYSICO CHEMICAL EVALUATION OF JKC

Parameters	JKC (%w/w)
Loss on drying at 105 ºC	9.55
Total ash	5.90
Acid-insoluble ash	0.35
Water soluble ash	2.60
Alcohol -soluble extractive	4.30
Water-soluble extractive	8.69
pH	5.6

TOTAL ETHANOL EXTRACTIVE VALUE JKC AND INGREDIENTS

Name	% Extract
Jambupallava	23.1
Amrapallava	9.54
Usheera	10.76
Vata	2.94
Asvattha	3.52
JKC	9.26

TLC PHOTO DOCUMENTATION OF ETHANOLIC EXTRACT OF JKC WITH INGREDIENTS

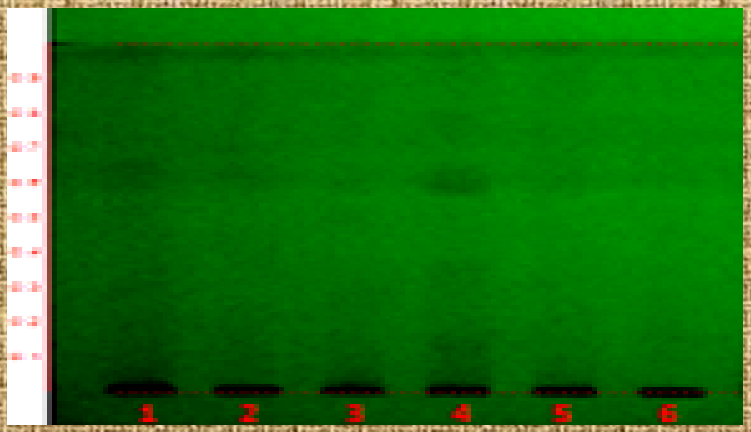


Fig 2.1 At 254 nm

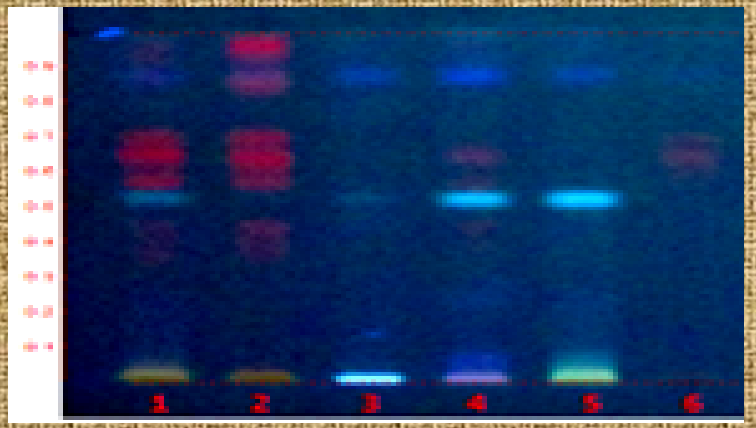


Fig 2.2 At 366 nm



Fig 2.3 Post Derivatisation

Solvent system - Toluene: Ethyl Acetate (16:2)

1 - Jambupallava (*Syzygium cumini*); 2 - Amrapallava (*Mangifera indica*)

3 - Usira (*Vetiveria zizanioides*); 4 - Vata (*Ficus bengalensis*)

5 - Asvattha (*Ficus religiosa*); 6 - Jambupallavadi Kvatha Curna (JKC)

Application volume 5 µl

R_F VALUES OF JKC AT 254 NM

Jambupallava	Amrapallava	Usira	Vata	Asvattha	JKC
-	-	-	0.13 L Green	-	-
0.30 L Green	**-**	**0.30 L Green**	**0.30 L Green**	-	-
-	-	-	0.36 L Green	-	-
-	0.45 L Green	-	-	-	-
-	-	0.50 L Green	-	-	-
-	-	-	0.61 Green	-	-
0.64 L Green	**0.64 L Green**	**-**	**-**	**0.64 L Green**	**0.64 L Green**
-	-	-	**0.76 Green**	**-**	**0.76 L Green**
0.87 L Green	**0.87 L Green**	**0.87 L Green**	-	-	-

R_F VALUES OF JKC AT 366 NM

Jambupallava	Amrapallava	Usira	Vata	Asvattha	JKC
-	-	-	**0.22 F Red**	**0.22 F Red**	-
0.35 F Red	**0.35 F Red**	-		-	-
-	-	-	0.38 F Red	-	-
0.44 F Red	**0.44 F Red**	**-**	**0.44 F Red**	-	-
0.52 F Red	**0.52 F Red**	**0.52 F Red**	**0.52 F Red**	**0.52 F Red**	-
0.56 F Red	0.56 F Red	-	-	-	-
-	-	-	**0.59 F Red**	**-**	**0.59 F Red**
0.63 F Red	**0.63 F Red**	-	-	-	-
-	-	-	**0.66 F Red**	**-**	**0.66 F Red**
0.69 F Red	0.69 F Red	-	-	-	-
-	-	-	-	-	0.71 F Red
-	0.86 F Red	-	-	-	-
0.88 F Red	**-**	**0.88 F Red**	**0.88 F Red**	**0.88 F Red**	**0.88 F Red**
0.97 F Red	**0.97 F Red**	**-**	**0.97 F Red**	-	-

R_F VALUES OF JKC AFTER DERIVATISATION

Jambupallava	Amrapallava	Usira	Vata	Asvattha	JKC
-	-	-	-	-	0.17 L Violet
0.20 Violet	**0.20 L Violet**	**-**	**-**	**0.20 L Violet**	-
-	-	-	0.25 L Violet	-	-
0.27 L Violet	-	-	-	-	-
		0.29 Violet	**0.29 Violet**	**-**	**0.29 Grey**
0.37 Violet	**0.37 L Violet**	-	-	-	0.37 Grey
-	-	**0.40 Violet**	**0.40 Violet**	**0.40 Violet**	-
-	-	0.48 Violet	-	0.48 L Violet	-
-	-	-	-	-	0.52 L Grey
0.56 Violet	**0.56 Violet**	**-**	**0.56 Violet**	**0.56 L Violet**	-
0.65 L Violet	0.65 L Violet	-	-	-	-
-	0.72 L Violet	-	-	-	-
0.87 L Violet	0.87 L Violet	-	-	-	-
-	0.92 Violet	-	-	-	-
0.97 Violet	**-**	**-**	**0.97 D Violet**	**0.97 L Violet**	-

3D DISPLAY DENSITOGRAMS

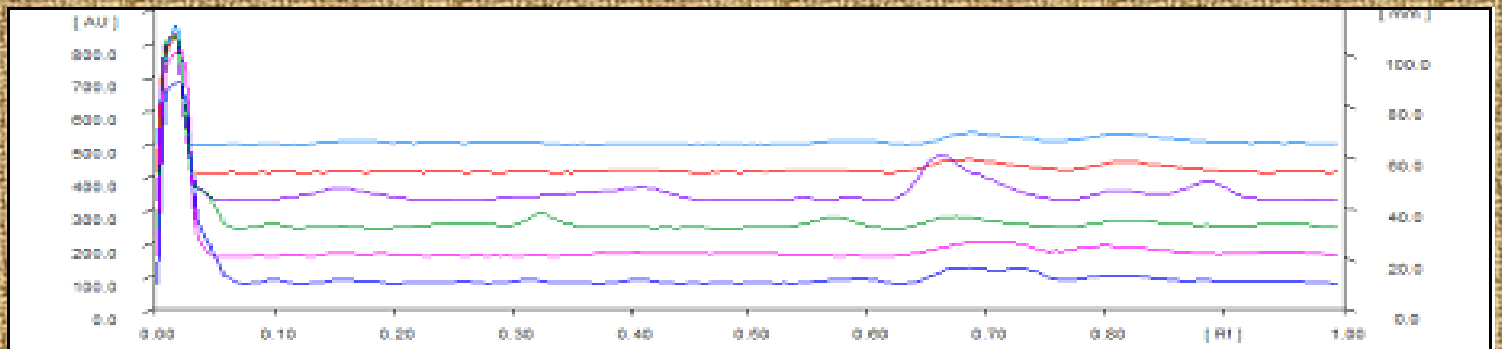


Fig 6.1 At 254 nm

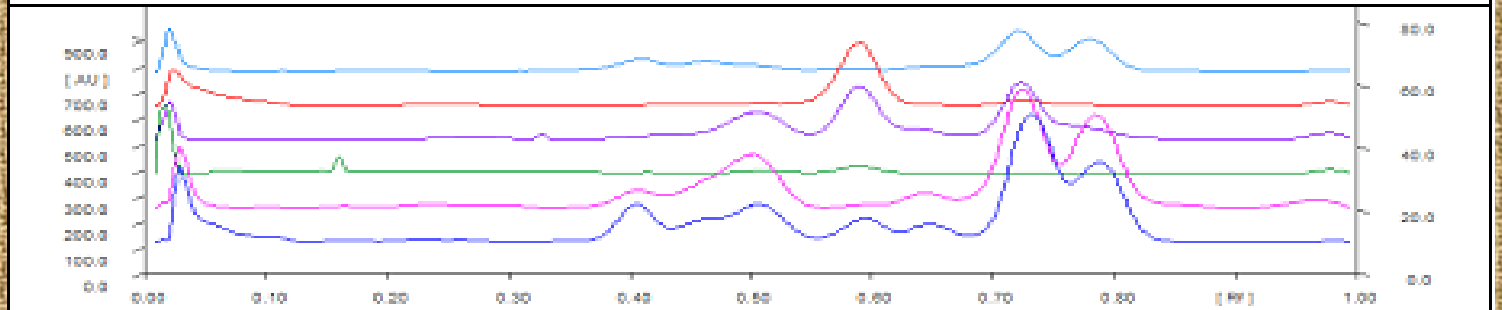


Fig 6.2 At 366 nm

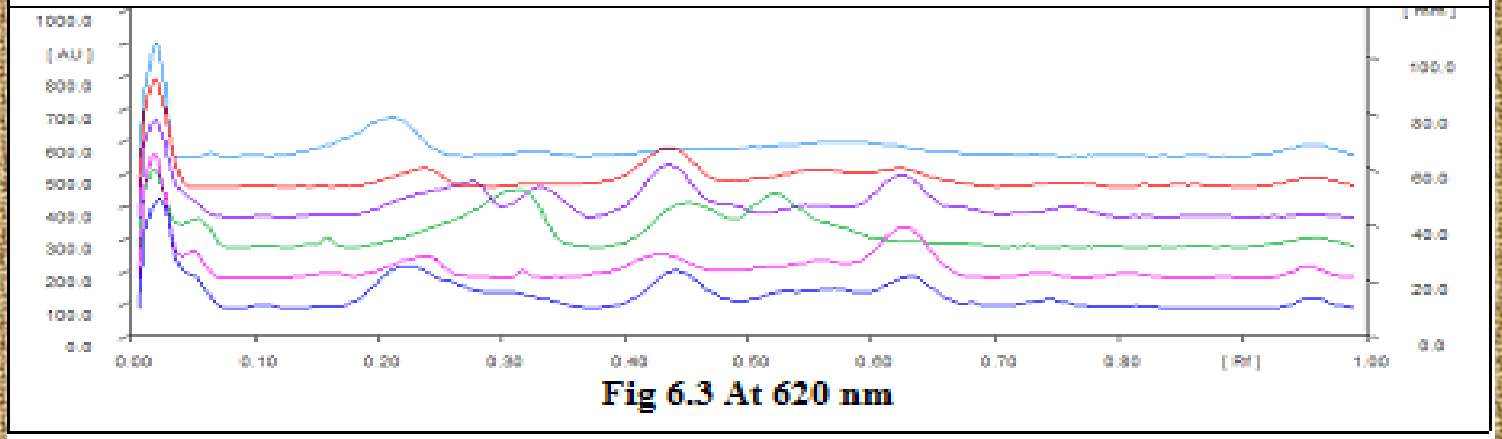
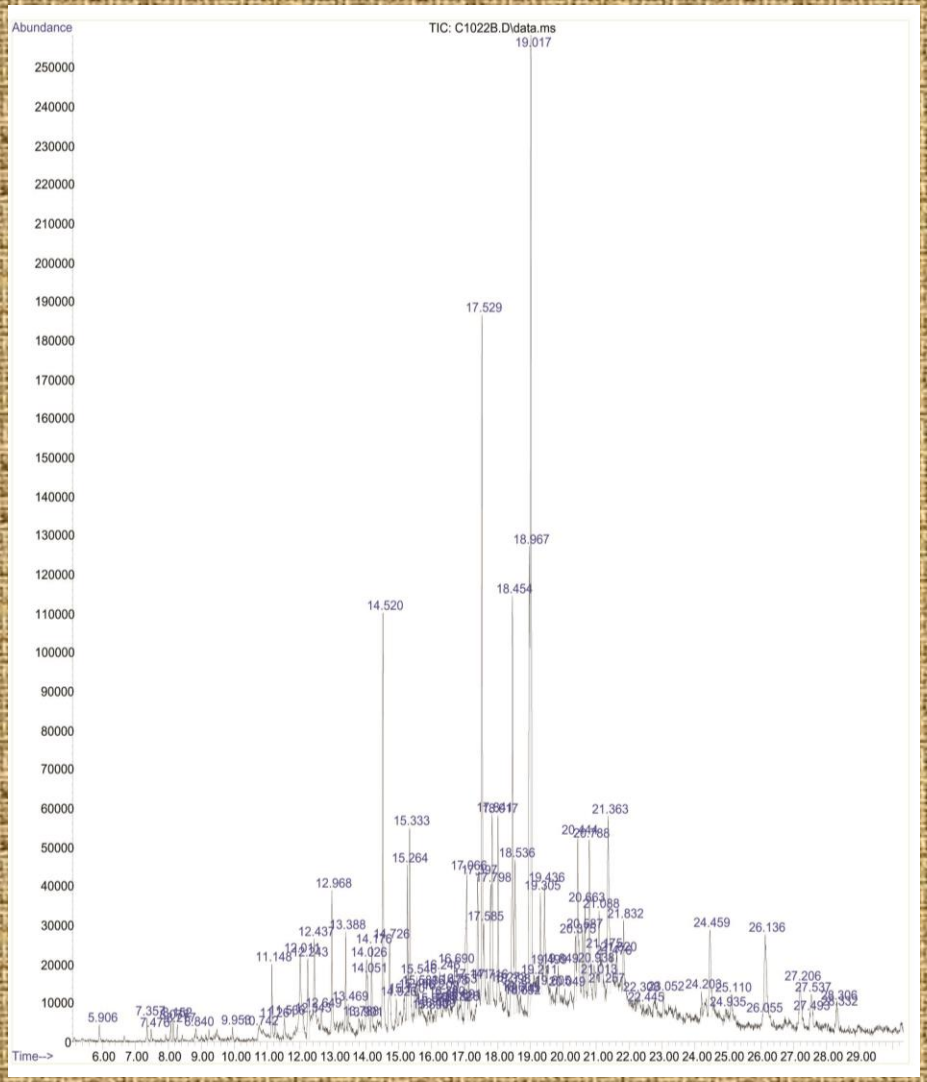
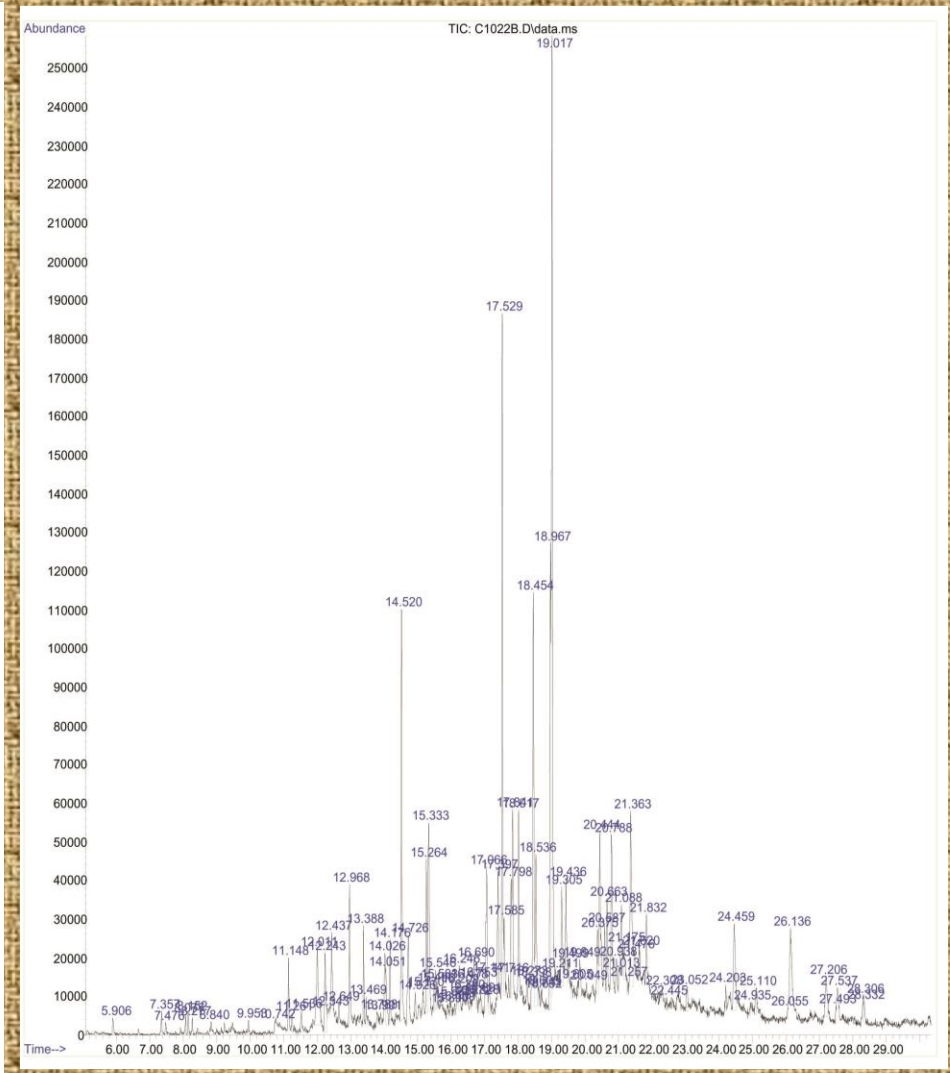


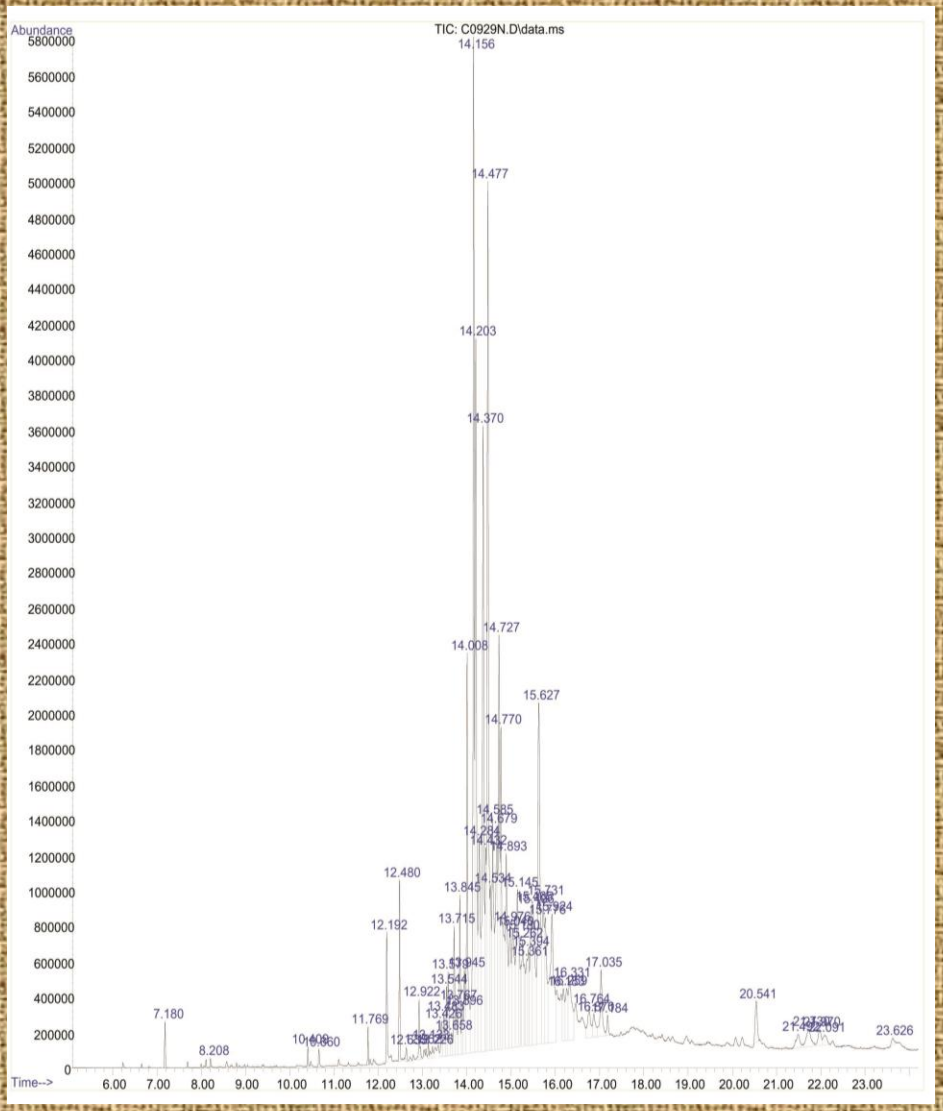
Fig 6.3 At 620 nm

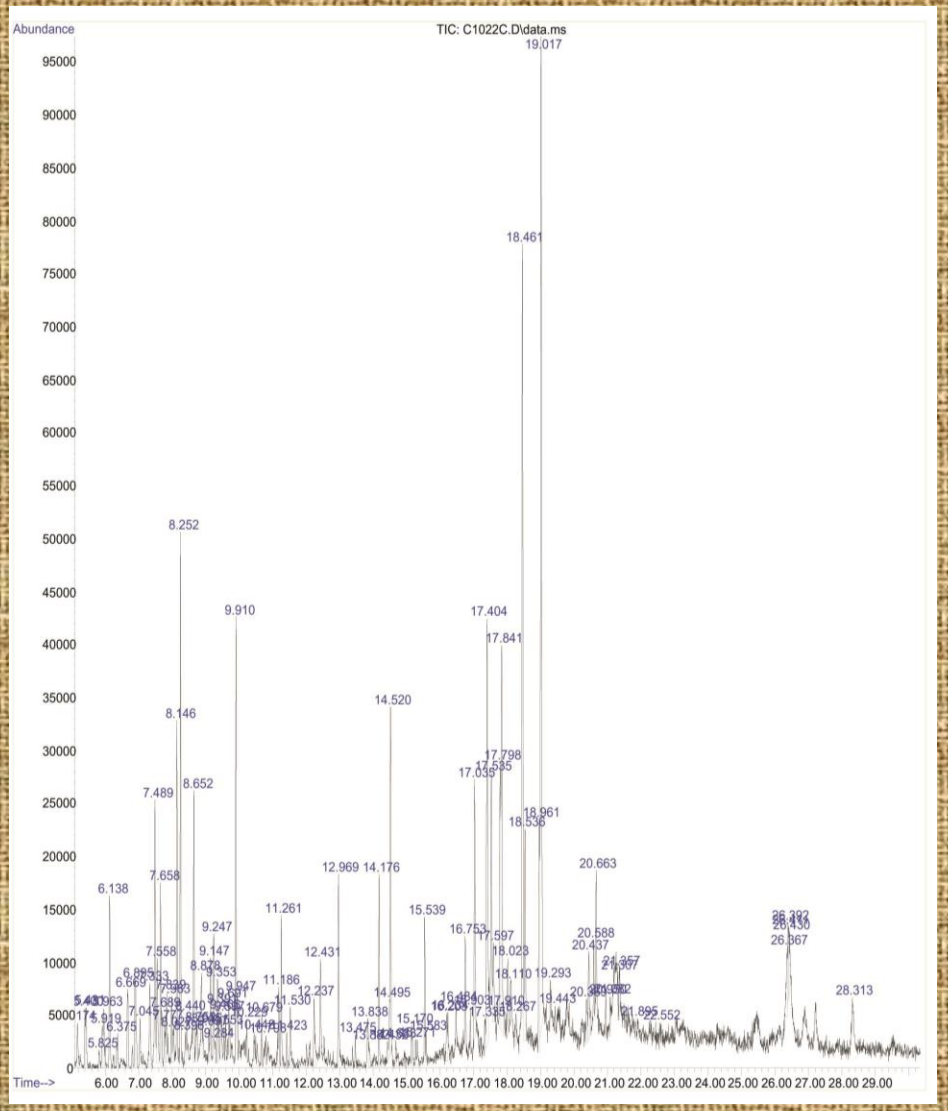
GC MS FINGERPRINT OF JAMBUPALLAVA AND AMRAPALLAVA



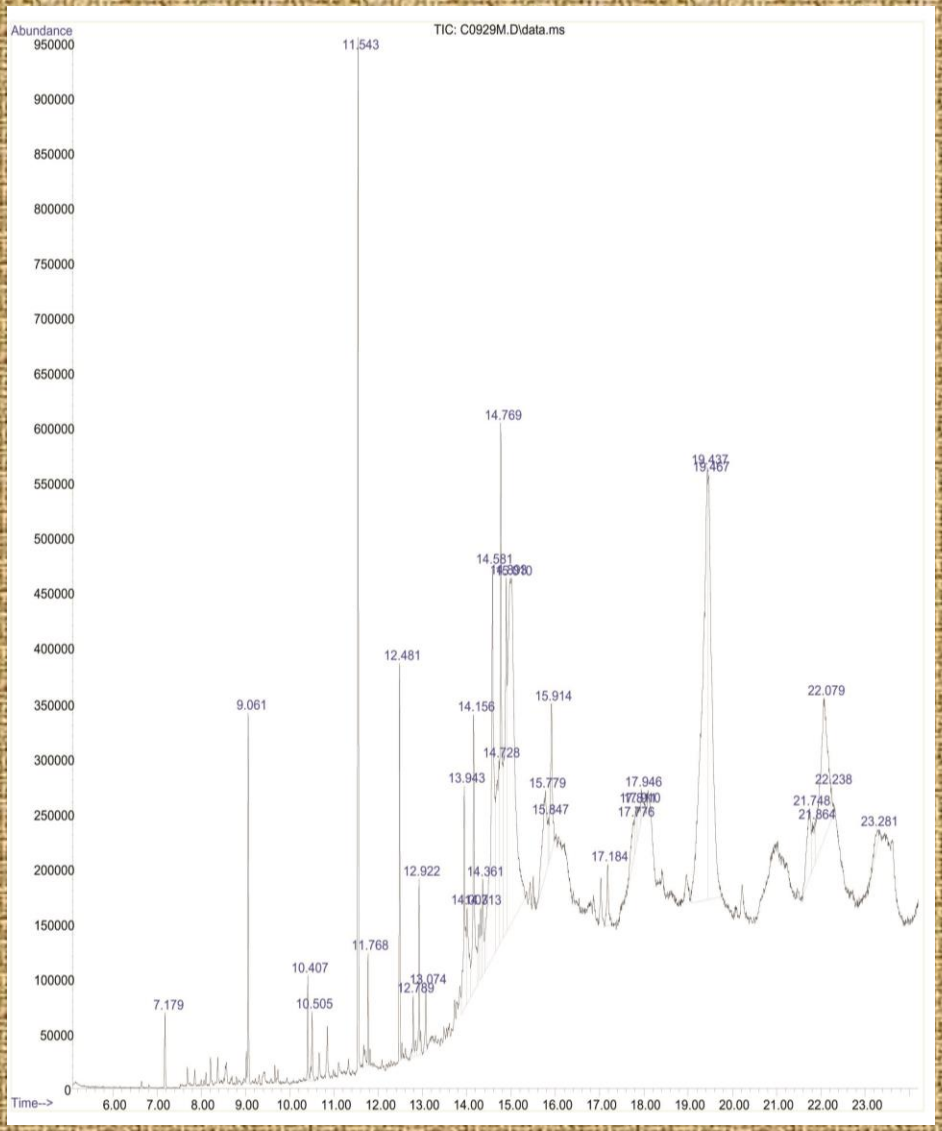


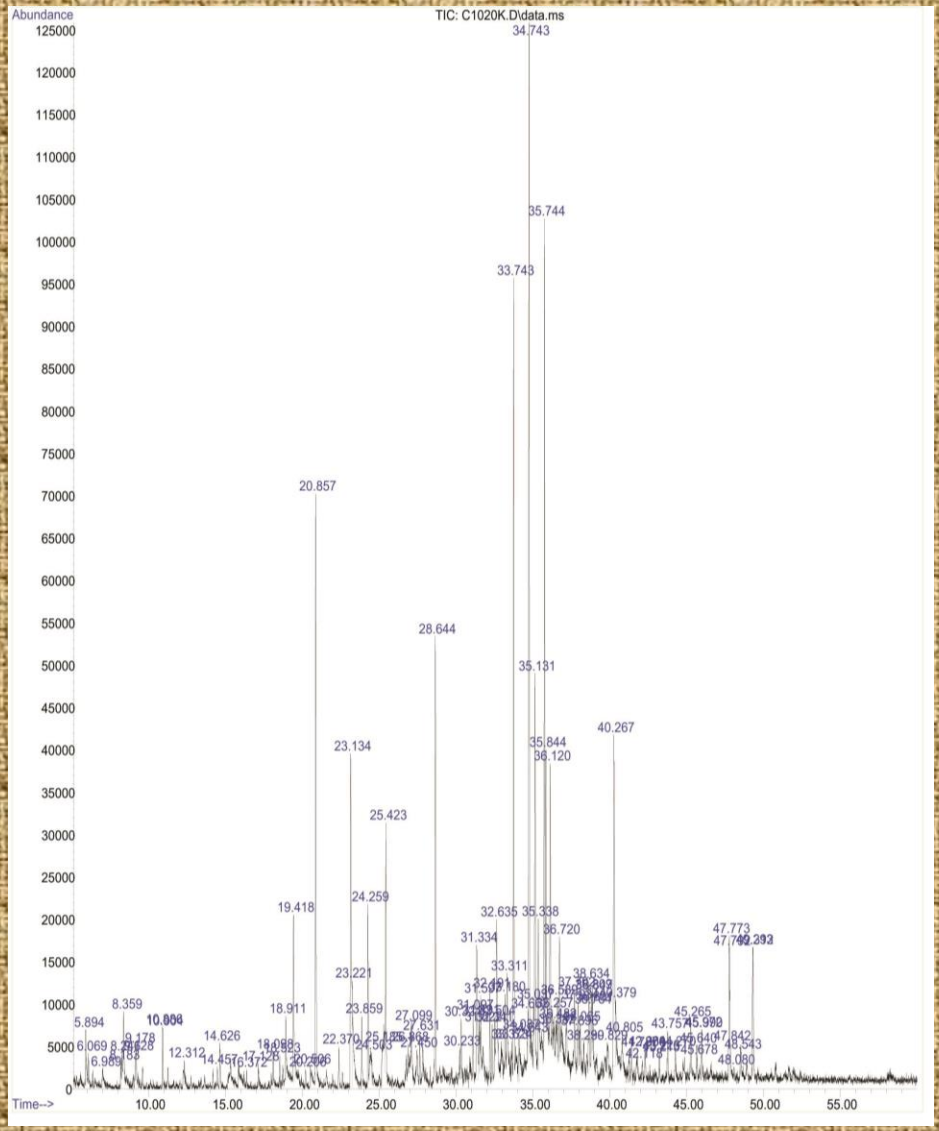
GC MS FINGERPRINT OF USHIRA AND VATA





GC MS FINGERPRINT OF ASHVATTHA AND JKC





23 COMPOUNDS IDENTIFIED FROM JAMBUPALLAVA

Styrene; 2,4-Heptadienal, (E,E)-; Benzaldehyde, 4-propyl-; Indole; Methyl anthranilate; 2-Tetradecene, (E)-; 2,5-Cyclohexadiene-1,4-dione, 2,6-; Phenol, 2,4-bis(1,1-dimethylethyl); Hexadecanoic acid, methyl ester; Trichloroacetic acid, pentadecyl Ester; 1,2-Benzenedicarboxylic acid, butyl 2-methylpropyl ester; 5-Eicosene, (E)-; Pentafluoropropionic acid, tetradecyl ester; 7,9-Di-tert-butyl-1-oxaspiro(4,5)deca-6,9-diene-2,8-dione; Hexadecanoic acid, methyl ester; n-Hexadecanoic acid; Dibutyl phthalate; Dichloroacetic acid, heptadecyl ester; 8-Hexadecyne; 9,12,15-Octadecatrienoic acid, methyl ester, (Z,Z,Z)-; Phytol; Octadecanoic acid; Heptadecyl trifluoroacetate.

34 COMPOUNDS IDENTIFIED FROM AMRAPALLAVA

Indolizine; Indolizine; Tridecane; Cyclohexasiloxane, dodecamethyl-; Methyl anthranilate; Cyclohexene, 1-methyl-4-(1-methylethylidene)-; Benzaldehyde, 4-propyl-;; Indole; .alfa.-Copaene; Benzene, 1-(1-methylethenyl)-2-(1-methylethyl)-; Dodecane, 2,6,10-trimethyl-; Cyclohexane, 1-ethenyl-1-methyl-2, 4-bis(1-methylethenyl)-, [1S-(1.alpha.,2.beta.,4.beta.)]-; .alpha.-Cubebene; Methyl anthranilate; Tetradecane; .beta.-copaene; Naphthalene, 1,2,3,4-tetrahydro-1, 6,8-trimethyl-; 1,4,7,-Cycloundecatriene, 1,5,9,9-tetramethyl-, Z,Z,Z-; (+)-epi-Bicyclosesquiphellandrene; .gamma.-Muurolene; Cycloheptasiloxane, tetradecamethyl; Longifolene-(V4); Bicyclo[4.4.0]dec-1-ene, 2-isopropyl-5-methyl-9-methylene-; Naphthalene, 1,2,3,4,4a,7-hexahydro-1,6-dimethyl-4-(1-methylethyl)-; Bicyclo[3.1.1]hept-2-ene, 2,6-dimethyl-6-(4-methyl-3-pentenyl)-; .alpha.-Muurolene; .alpha.-Farnesene; Naphthalene, 1,2,3,4,4a,5,6,8a-octahydro-7-methyl-4-methylene-1-(1-methylethyl)-, (1.alpha.,4a.beta.,8a.alpha.)-; Naphthalene, 1,2,3,5,6,8a-hexahydro-4,7-dimethyl-1-(1-methylethyl)-, (1S-cis)-; 1H-3a,7-Methanoazulene, octahydro-3,8,8-trimethyl-6-methylene-, [3R-(3.alpha.,3a.beta.,7.beta.,8a.alpha.)]-; Naphthalene, 1,2,4a,5,6,8a-hexahydro-4,7-dimethyl-1-(1-methylethyl)-,[1R-(1.alpha.,4a.alpha.,8a.alpha.)]-; .alpha.-Calacorene; Sesquirosefuran; Hexadecane.

23 COMPOUNDS IDENTIFIED FROM USHIRA

Styrene; Benzaldehyde; 1-Decene; Ethanol, 2-phenoxy-; 2-Tetradecene, (E)-; trans-Isoeugenol; Phenol, 2,5-bis(1,1-dimethylethyl); 1-Hexadecanol; 1H-Cyclopenta[1,3]cyclopropa[1,2]benzene, octahydro-7-methyl-3-methylene-4-(1-methylethyl)-, [3aS-(3a. alpha.,3b.beta.,4.beta.,7.alpha.,7aS*)]-; (2Z,4E)-3,7,11-Trimethyl-2,4,10-dodecatriene; 1H-3a,7-Methanoazulene-6-methanol, 2,3,4,7,8,8a-hexahydro-3,8,8-trimethyl-, [3R-(3.alpha.,3a.beta.,7.beta.,8a.alpha.)]-; 1-Octadecene; 2-Naphthalenecarboxylic acid, 8-ethenyl-3,4,4a,5,6,7,8,8a-octahydro-5-methylene-; 7,9-Di-tert-butyl-1-oxaspiro(4,5)deca-6,9-diene-2,8-dione; n-Hexadecanoic acid; Dibutyl phthalate; Alloaromadendrene; Octadecanoic acid; 9-Octadecenamide, (Z)-; Cyclotetracosane; Phenol, 4-[2,3-dihydro-7-methoxy-3-methyl-5-(1-propenyl)-2-benzofuranyl]-2-methoxy-; Eicosane; Nonacosane;.

14 COMPOUNDS IDENTIFIED FROM VATA

Ethylbenzene; p-Xylene; Nonane; Benzene, propyl-; Mesitylene; Benzene, 1,2,3-trimethyl-; Decane; Benzene, 1-methyl-3-propyl-; Benzene, 2-ethyl-1,4-dimethyl-; Undecane; Methyl anthranilate; 2,5-Cyclohexadiene-1,4-dione, 2,6-; Phenol, 2,4-bis(1,1-dimethylethyl); 7,9-Di-tert-butyl-1-oxaspiro(4,5)deca-6,9-diene-2,8-dione; Hexadecanoic acid, methyl ester; Dibutyl phthalate.

17 COMPOUNDS IDENTIFIED FROM ASWATTHA

Styrene; Eucalyptol; Terpinen-4-ol; L-.alpha.-Terpineol; 3-Cyclohexene-1-methanol, .alpha., .alpha.,4-trimethyl-, acetate; 3-Tetradecene, (Z)-; Phenol, 2,5-bis(1,1-dimethylethyl); 2-Tetradecene, (E)-; 1-Octadecene; 7,9-Di-tert-butyl-1-oxaspiro(4,5)deca-6,9-diene-2,8-dione; 1-Heptacosanol; 1-Nonadecene; 1-Heptacosanol; Olean-12-ene-3,28-diol, (3.beta.)-; Olean-12-ene-3,28-diol, (3.beta.)-; Methyl 3.beta.-hydroxyolean-18-en-28-oate; Methyl 3.beta.-hydroxyolean-18-en-28-oate.

16 COMPOUNDS IDENTIFIED FROM JKC

Phenol, 3-methyl-; Benzyl alcohol; Benzaldehyde, 4-propyl-; Indole; Methyl anthranilate; Cyclohexanamine, N-cyclohexyl-; Eugenol; 2,5-Cyclohexadiene-1,4-dione, 2,6-bis(1,1-dimethylethyl)-; Phenol, 2,4-bis(1,1-dimethylethyl); Cyclooctasiloxane, hexadecamethyl-; Pyrrolo[1,2-a]pyrazine-1,4-dione, hexahydro-; Benzaldehyde, 2,3,4,5-tetramethyl-; 1,2-Benzenedicarboxylic acid, bis(2-methylpropyl) ester; Dibutyl phthalate; n-Hexadecanoic acid; 1,2-Benzenedicarboxylic acid, butyl octyl ester.

PROS AND CONS OF COMPOSITIONAL FINGERPRINTS (CFs)

- Testing laboratories with minimum facilities cannot afford sophisticated CFs
- Variation in composition of extract might influence the fingerprint pattern
- CFs cannot be performed for all kinds of metabolites (eg. High melting constituents cannot be analyzed by GCMS)
- CFs will help to understand pharmacology of the extract to some extent
- CFs may be a way forward for global acceptance of TMs

CONCLUSION

- Herbal/Polyherbal preparations of TMs requires sophisticated fingerprint technology (FPT) of their complex nature
- Compositional fingerprinting like GCMS is a good technique compared to other fingerprinting like HPTLC using single marker
- Regulatory authorities may revise Pharmacopoeial tests for PTMs by incorporating sophisticated FPT while prescribing standards

THANK YOU