Indian Scenario of Quality Control & Standardization of Ayurveda Drugs

Presentation by

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Min. of Health & Family Welfare
Govt. of India

AYURVEDA

YOGA & NATUROPATHY

UNANI

SIDDHA

HOMOEOPATHY

- Established in 1995 as ISM (Indian Systems of Medicine)
- Renamed AYUSH in 2003.
**Charak Samhita**

- **Period**: 1000 B.C.
- **Description**: The book contains 120 chapters focusing on **Internal medicine**.

**Sushrut Samhita**

- **Period**: 800 B.C.
- **Description**: This book contains 186 chapters focusing on **Surgery, Eye, ENT, Gynae & Obstetrics**.

**Ashtang Samgraha**

- **Period**: 6th Cent. A.D.
- **Description**: This popular book contains 150 chapters on **fundamental principles, diagnosis and treatment**.

**Madhav Nidan**

- **Period**: 10th Cent. A.D.
- **Description**: The book contains 70 chapters on **diagnostic features, signs and symptoms of various disease**.

**Sharangdhar Samhita**

- **Period**: 13th Cent. A.D.
- **Description**: The 32 chapters of this book mainly focuses on **pharmacy based dosage forms in various clinical conditions**.

**Bhavprakash Samhita**

- **Period**: 16th Cent. A.D.
- **Description**: The book with 109 chapters on **materia medica has description of plant drugs, minerals, metals, animal byproducts etc.**
Use of Food Items as Ayurvedic Medicines / Ingredients

- Food items are enormously used in Ayurveda as Medicines.

- Out of plant drugs covered under Ayurvedic Pharmacopoeia of India, around 25% are from Food Items.

- A few commonly used food categories which are also used as medicines are listed below:
  - Spices / Condiments
  - Cereals
  - Pulses
  - Vegetables
  - Fruits
**HUMAN BEING**
(Soul + Intellect + Mind + Body)

<table>
<thead>
<tr>
<th>Food:</th>
<th>Human body - Three Dosha:</th>
<th>Drugs:</th>
</tr>
</thead>
<tbody>
<tr>
<td>V</td>
<td>1. <em>Vatta</em></td>
<td>V</td>
</tr>
<tr>
<td>P</td>
<td>2. <em>Pitta</em></td>
<td>P</td>
</tr>
<tr>
<td>K</td>
<td>3. <em>Kapha</em></td>
<td>K</td>
</tr>
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</table>

**Five elements:**

<table>
<thead>
<tr>
<th>S</th>
<th>1. Space</th>
<th>S</th>
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<tbody>
<tr>
<td>A</td>
<td>2. Air</td>
<td>A</td>
</tr>
<tr>
<td>F</td>
<td>3. Fire</td>
<td>F</td>
</tr>
<tr>
<td>W</td>
<td>4. Water</td>
<td>W</td>
</tr>
<tr>
<td>E</td>
<td>5. Earth</td>
<td>E</td>
</tr>
</tbody>
</table>
Regulation of AYUSH System

1. Regulation of Education- Teaching & Training
   Council- CCIM under IMCC Act 1970

2. Regulation of Clinical Practice
   Mandatory Registration of Practitioners under IMCC Act 1970

3. Regulation of Drugs
   Indian Drugs & Cosmetics Act, 1940
   Mandatory Manufacturing Licensing of Drugs
   Mandatory GMP (on WHO guidelines)
REGULATORY LAWS

- Indian Medicine Central Council (IMCC) Act, 1970 For Education & Clinical practices
- Indian Drugs & Cosmetics Act, 1940
- Food Safety Act
- Drugs & Magic Remedies (Objectionable Advertisements) Act
- Bio-diversity Act
- Wild Life Protection Act
- Indian Forests Act
LAW FOR EDUCATION OF AYURVEDA

• Indian Medicine Central Council (I.M.C.C.) Act 1970

• Uniform Syllabus and Teaching Standards in the country.

• Degrees / M.D. – Ayush Awarded by Universities (5 ½ yrs B.A.M.S. + 3 yrs M.D.)
• Indian Medical Central Council (I.M.C.C.) ACT 1970 for Ayurveda, Siddha & Unani practitioners.

• Registration of practitioners is mandatory.

• Registration requires possession of recognized degree qualification in Ayurveda.

• Qualifications awarded by universities are included in the Act with the approval of Central Government.
REGULATION OF AYURVEDIC / ASU DRUGS

- Indian Drugs & Cosmetic Act- 1940 deal with allopathy & AYUSH drugs
- A separate chapter (chapter-IV) and rules for Ayurveda, Siddha and Unani drugs.
- ASU Drug Technical Advisory Board for matters related to quality control and standardization
- ASU Drug Consultative Committee of all the state Drug Controllers of ASU to implement the provisions of the Act.
- Licensing of manufacturing units and drugs is mandatory.
• Central Government empowered to prohibit manufacture and sale of certain drugs in public interest.

• Government **Drug Analysts**- Qualifications and Duties.

• Appointment of **Drug inspectors**.

• **Penalty** for manufacture, sale etc. of drugs in contravention of Act.

• To prescribe methods of drug testing and analysis- as per pharmacopoeia.
Contd...

- Listing of **schedule E drugs** – poisonous materials.
- **Penalty** for misbranded, adulterated and spurious drugs for punitive action.
- Compulsory Good Manufacturing Practices (GMP).
- Labeling/Packing provisions for Export / Domestic use.
- Recognition of private and public drug testing laboratories for sample analysis.
- Compulsory testing and Certification for export.
Status of GMP Compliance

• Schedule ‘T’, GMP- has been made mandatory since 2005.

• GMP Compliant Manufacturing Units- 4142
Pharmacovigilance for Ayurveda Medicines

- National Pharmacovigilance resource centre has been established in 2008 at Gujarat Ayurveda University, Jamnagar
- State Centres has been identified in 20 states.
- Regional training programme has been conducted for reporting the ADR
- UG/PG Teaching institutions are educated on Pharmacovigilance ADR etc.
Quality & Standardization of ASU Drugs

I. Single Drugs (540)
- Plants
- Metals
- Minerals
- Extracts

II. Multiple Ingredient Formulations (600)
- Only Plant Based Mixtures
- Herbo-mineral / Metal / Calcined metals / Metal Ashes
- Herbo-mineral / Animal by products

III. Various Pharmaceutical Dosage forms (25)

IV. Efficacy Studies
- SOP of manufacturing process. testing procedures
- For various Dosage forms for

V. Safety Studies
- Herbo-mineral / metallic Rasayogas

IV. Efficacy Studies
- On standard protocols
QUALITY STANDARDS OF DRUGS
AYURVEDIC PHARMACOPOEIA OF INDIA

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

- UPC for Unani medicine and SPC for Siddha Medicine

- 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.
Standardization of Raw drugs and Ayurvedic formulations
### Ayurvedic Pharmacopoeia of India (on Single Drugs):

<table>
<thead>
<tr>
<th>Publication of Ayurvedic Pharmacopoeia</th>
<th>Year</th>
<th>No. of drugs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Ayurvedic Pharmacopoeia of India Vol. I</td>
<td>1986</td>
<td>80</td>
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<td>2. Ayurvedic Pharmacopoeia of India Vol. II</td>
<td>1999</td>
<td>78</td>
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<td>3. Ayurvedic Pharmacopoeia of India Vol. III</td>
<td>2001</td>
<td>100</td>
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<td>4. Ayurvedic Pharmacopoeia of India Vol. IV</td>
<td>2004</td>
<td>68</td>
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<tr>
<td>5. Ayurvedic Pharmacopoeia of India Vol. V</td>
<td>2006</td>
<td>92</td>
</tr>
<tr>
<td>6. Ayurvedic Pharmacopoeia of India Vol. VI</td>
<td>2008</td>
<td>101</td>
</tr>
<tr>
<td>7. Ayurvedic Pharmacopoeia of India Vol. VII (Minerals and Metals)</td>
<td>2008</td>
<td>21</td>
</tr>
<tr>
<td>8. TLC Atlas of Ayurvedic Pharmacopoeial drugs 2009</td>
<td></td>
<td>80*</td>
</tr>
<tr>
<td>Part I, Vol I</td>
<td></td>
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</tr>
</tbody>
</table>

**Total Monographs** = 540 (80* + 92**)
# Unani & Siddha Pharmacopoeia

<table>
<thead>
<tr>
<th></th>
<th>Unani Pharmacopoeia of India-Vol</th>
<th>Single Drugs</th>
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<td>45</td>
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<td>2.</td>
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<td>50</td>
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<td>3.</td>
<td>Unani Pharmacopoeia of India-Vol III</td>
<td>53</td>
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<td>4.</td>
<td>Unani Pharmacopoeia of India-Vol IV</td>
<td>50</td>
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<td>5.</td>
<td>Unani Pharmacopoeia of India-Vol V</td>
<td>52</td>
</tr>
<tr>
<td>6.</td>
<td>Siddha Pharmacopoeia of India</td>
<td>73</td>
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</table>
THE
AYURVEDIC
PHARMACOPOEIA
OF
INDIA
Volume - V
First Edition

GOVERNMENT OF INDIA
MINISTRY OF HEALTH AND FAMILY WELFARE
DEPARTMENT OF AYURVEDA, YOGA-NATUROPATHY,
UNANI, SIDDHA & HOMOEOPATHY (AYUSH)
NEW DELHI
THE
AYURVEDIC
PHARMACOPOEIA
OF
INDIA

PART - I
VOLUME - VII
(Minerals & Metals)

First Edition

GOVERNMENT OF INDIA
MINISTRY OF HEALTH AND FAMILY WELFARE
DEPARTMENT OF AYURVEDA, YOGA & NATUROPATHY, UNANI, SIDDHA
AND HOMOEOPATHY (AYUSH)
NEW DELHI
COMPONENTS OF AYURVEDIC MEDICINES

- Plants: 90-95%
- Minerals: 2-3%
- Metals: 2-3%
- Animal Byproducts: 1-2%
- Marine Products: 1-2%

These are used in single and in multiple ingredients formulations.
Standardization of Herbal Ayurvedic Formulations

For Global Competitiveness:

**Raw materials**
- Authentication
- Physico, chemical, biological limits
- Storage conditions
- Size/shape/right quality
- Chromatographic fingerprint

**Process**
- Material/energy inputs
- Operational uniformity
- Safety and occupational health
- Intermediate quality [in process quality control]
- Chromatographic fingerprint

**Finished Product**
- Organoleptic
- Physico chemical properties
- Chromatographic fingerprint
- Assay [Chemical / biological]
- Storage stability
- User safety
- Packaging and labelling
AIM

CONTROL OF PRODUCT QUALITY IN TERMS OF:

- Identity
- Purity
- Strength

• PLANT DRUGS -> UNPROCESSED PLANT PARTS AS DRUGS (PD)

Quality, Safety and Efficacy are inter-related issue.
Pharmacopoeial Standards of Ayurvedic Drugs

Reference: Pharmacopoeia of India (API) Monograph

1. Official - name of the drug - Sanskrit/Ayurvedic
2. General Introduction:
3. Synonyms & Regional names etc.
4. Description:
   (a) Macroscopic, description
   (b) Microscopic (Pharmacognostic), description
      - Root - Flower
      - Stem - Fruit
      - Leaf - Seed
5. Powder - diagnostic features
6. Chemical constituents
Standards of Identity, Purity and Strength

7. Foreign matter - not more than.....%
8. Total Ash - not more than.....%
9. Acid insoluble ash - not more than.....%
10. Alcohol soluble extraction - not less than.....%
11. T.L.C. (IDENTITY TEST) (with method & description)
12. In some cases assay method of major chemical constituent
13. Properties and Action:
   (i) Rasa (Taste)
   (ii) Guna (Properties)
   (iii) Virya (Predominant action)
   (iv) Vipaka (Metabolic action)
   (v) Karma (Pharmacological action)
1. Test for Heavy Metals Limits (WHO Limits)
2. Microbial Load Limits
3. Aflatoxins
4. Important Formulations:
5. Therapeutic Uses:
6. Dose:
7. Authentic/Textual References
Development of Pharmacopoeial Standards of Extracts of Medicinal Plants

Extracts  a  Aqueous (Water)
         b  Hydro-alcoholic

• In total 30 plants extracts have been developed and will be published soon
Pharmacopoeial Monograph of Plant Extracts

- Definition
- Method of Preparation
- Standards
- *Description*
- *Identification*
- **Physico-chemical parameters:**
  - *Loss on drying*
  - *Total ash*
  - *Acid-insoluble ash*
  - *pH of 5% w/v suspension*
Contd….

• **Other requirements:**
  – Heavy metals test
  – Microbial tests
  – Pesticide residue
  – Residual solvent
  – Aflatoxins

• **Assay:** Determine by liquid chromatography
  (Assay of marker compound/ active principle wherever applicable/ available)

• **Shelf-life:**
• **Storage and Packaging:**
• **Use:**
• **Dose:**
## Water and Hydro-alcoholic Extract Standards Ready for Publication

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Name of the Drug</th>
<th>Botanical Name</th>
<th>Part Used</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Yashtimadhu</td>
<td><em>Glycyrrhiza glabra</em></td>
<td>Rt.</td>
</tr>
<tr>
<td>2.</td>
<td>Shatavari</td>
<td><em>Asparaghas racemosus</em></td>
<td>Rt.</td>
</tr>
<tr>
<td>3.</td>
<td>Vasa</td>
<td><em>Adhatoda vasica</em></td>
<td>Lf</td>
</tr>
<tr>
<td>4.</td>
<td>Arjuna</td>
<td><em>Terminalia arjuna</em></td>
<td>St. Bk.</td>
</tr>
<tr>
<td>5.</td>
<td>Haridra</td>
<td><em>Curcuma longa</em></td>
<td>Rz.</td>
</tr>
<tr>
<td>6.</td>
<td>Amalaki</td>
<td><em>Emblica offinalis</em></td>
<td>Fr. P</td>
</tr>
<tr>
<td>8.</td>
<td>Bibhitaka</td>
<td><em>Terminalia beilerica</em></td>
<td>Fr. P</td>
</tr>
<tr>
<td>9.</td>
<td>Haritaki</td>
<td><em>Terminalia chebula</em></td>
<td>Fr. P</td>
</tr>
<tr>
<td>10.</td>
<td>Bhringaraja</td>
<td><em>Eclipta alba</em></td>
<td>Lf</td>
</tr>
<tr>
<td>12.</td>
<td>Mandukaparni</td>
<td><em>Centella asiatica</em></td>
<td>Wh. Pl.</td>
</tr>
</tbody>
</table>
### Water and Hydro-alcoholic Extract Standards in pipeline

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Name of the Drug</th>
<th>Botanical Name</th>
<th>Part Used</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Apamarga</td>
<td>Achyranthus aspera</td>
<td>Pl.</td>
</tr>
<tr>
<td>2</td>
<td>Sirisa</td>
<td>Albizia lebbek</td>
<td>St. Bk.</td>
</tr>
<tr>
<td>3</td>
<td>Manjistha</td>
<td>Rubia cordifolia</td>
<td>Rt.</td>
</tr>
<tr>
<td>4</td>
<td>Goksura</td>
<td>Tribulus terrestris</td>
<td>Fr.</td>
</tr>
<tr>
<td>5</td>
<td>Nirgundi</td>
<td>Vitex nigundo</td>
<td>Lf</td>
</tr>
<tr>
<td>6</td>
<td>Varuna</td>
<td>Crataeva nurvala</td>
<td>St. Bk.</td>
</tr>
<tr>
<td>7</td>
<td>Mesasringi</td>
<td>Gymnema sylvestre</td>
<td>Lf</td>
</tr>
<tr>
<td>8</td>
<td>Katuka</td>
<td>Picrorhiza kurroa</td>
<td>Rt. &amp; Rz.</td>
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<tr>
<td>9</td>
<td>Methika</td>
<td>Trigonella foenum-graceum</td>
<td>Sd.</td>
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<td>10</td>
<td>Kutaja</td>
<td>Holarrhena antidysenterica</td>
<td>St. Bk.</td>
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<tr>
<td>11</td>
<td>Shallaki</td>
<td>Boswellia serrata</td>
<td>Exudate</td>
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<tr>
<td>12</td>
<td>Svarnapatri</td>
<td>Cassia angustifolia</td>
<td>Leaf</td>
</tr>
<tr>
<td>13</td>
<td>Nimba</td>
<td>Azadirachta indica</td>
<td>Leaf</td>
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<tr>
<td>14</td>
<td>Tulasi</td>
<td>Ocimum sanctum</td>
<td>Leaf</td>
</tr>
<tr>
<td>15</td>
<td>Tagara</td>
<td>Valeriana jatamansi</td>
<td>Leaf</td>
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<tr>
<td>S.No.</td>
<td>Name of the Drug</td>
<td>Botanical Name</td>
<td>Part Used</td>
</tr>
<tr>
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<tr>
<td>16.</td>
<td>Vrksamal</td>
<td><em>Garcinia indica</em></td>
<td>Fr.</td>
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<tr>
<td>17.</td>
<td>Sunthi</td>
<td><em>Zingiber officinalis</em></td>
<td>Rz.</td>
</tr>
<tr>
<td>18.</td>
<td>Karvellaka</td>
<td><em>Momordica charantia</em></td>
<td>Fr.</td>
</tr>
<tr>
<td>23.</td>
<td>Daru haridra</td>
<td><em>Berberis aristata</em></td>
<td>Pl.</td>
</tr>
<tr>
<td>24.</td>
<td>Punarnava</td>
<td><em>Boerrhavia diffusa</em></td>
<td>Pl.</td>
</tr>
<tr>
<td>25.</td>
<td>Shankhapushpi</td>
<td><em>Convolvulus pluricaulis</em></td>
<td>Pl.</td>
</tr>
<tr>
<td>26.</td>
<td>Bilva</td>
<td><em>Aegle marmelos</em></td>
<td>St. Bark</td>
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<tr>
<td>27.</td>
<td>Bharangi</td>
<td><em>Clerodendrum phlomidis</em></td>
<td>Wh. Pl.</td>
</tr>
<tr>
<td>28.</td>
<td>Agnimanth</td>
<td><em>Premna integrifolia</em></td>
<td>St. Bark</td>
</tr>
<tr>
<td>29.</td>
<td>Gambhari</td>
<td><em>Gmelina arborea</em></td>
<td>St. Bark</td>
</tr>
<tr>
<td>30.</td>
<td>Patala</td>
<td><em>Stereospermum suaveolens</em></td>
<td>St. Bark</td>
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<tr>
<td>31.</td>
<td>Syonaka</td>
<td><em>Oroxylum indicum</em></td>
<td>St. Bark</td>
</tr>
</tbody>
</table>
Thin Layer Chromatography (TLC)

Atlas of Ayurvedic Pharmacopoeial drugs.
API Part-I Vol.1- 80 drugs

2009 Publication
Haridra-Curcuma longa

Legends
A : Curcuma longa
B : Curcuma longa dried rhizome
C : Chromatogram under UV 254 nm
D : Chromatogram under UV 366 nm
E : Chromatogram under visible light (after derivatization)

1 : Band corresponding to Curcumin (Rf ~0.52)
2 : Band corresponding to Demethoxycurcumin (Rf ~0.41)
3 : Band corresponding to Bis demethoxycurcumin (Rf ~0.26)

S : Start
F : Finish
T1 : Reference standard (Curcuminoids)
T2 : Hydroalcoholic extract of Curcuma longa rhizome

T1 T2 T1 T2 T1 T2
Aragvadh- *Cassia fistula*

Fig. 1: *Cassia fistula*

Flowering Twig

Fruit Pulp

Fig. 2: TLC finger print of test solution of *Cassia fistula*

1 : Test solution of T1,  
2 : Test solution of T2  

I : 254 nm,  
II : 366 nm,  
III : 

After derivatization
**Bilwa- Aegle marmelos**

Fig. 1: *Aegle marmelos*

Fruiting Twig  
Fruit Pulp

Fig. 2: TLC finger print of test solution of *Aegle marmelos*

1 : Test solution of T1, I : 366 nm,
2 : Test solution of T2 II : After derivatization
Macro / Microscopy

Atlas of Ayurvedic Pharmacopoeial drugs

API Part- I Vol V

2009 Publication
MACROSCOPIC & MICROSCOPIC
ATLAS OF PHARMACOPOEIAL DRUGS
(AYURVEDIC PHARMACOPOEIA OF INDIA)
PART - I
VOLUME - V

GOVERNMENT OF INDIA
MINISTRY OF HEALTH AND FAMILY WELFARE
DEPARTMENT OF AYURVEDA, YOGA & NATUROPATHY, UNANI, SIDHHA
AND HOMEOPATHY (AYUSH)
NEW DELHI
2009
Amra Haridra (Rhizome)
*Curcuma amada* Roxb.

Macroscopic characters

Whole plant

Rhizomes

Cut pieces of rhizome
Amra Haridra (Rhizome)
Curcuma amada Roxb.

Microscopic characters

Abbreviations: - cb., cortical bundle; cen.cy., central cylinder; ct., cortex; endo., endodermis; epi., epidermis; hr., hair; lys.o.g., lysigenous oil gland; med. b., medullary bundle; oc., oil cell; per., pericycle; pri.cor., primary cortex; sch.o.d., schizogenous oil duct; sec.cor., secondary cortex; sg., starch grain.
Amra Haridra (Rhizome)
Curcuma amada Roxb.

Powder characteristics

- Cork cells
- Fibres
- Vessel
- Oil cells
- Starch grains
- Parenchyma
Jalapippali (Whole plant)
*Phyla nodiflora* Greene

Macroscopic characters

Plant

Whole plant (dried)
Jalapippali (Whole plant)
*Phyla nodiflora* Greene

Microscopic characters

**Abbreviations:** - ac, air cavity; ct, cortex; epib, epiblema; end, endodermis; ph, phloem; xy, xylem.
Jalapippali (Whole plant)
*Phyla nodiflora* Greene

**Microscopisc characters**

**Abbreviations:** - chl, chlorenchyma; col, collenchyma; cu, cuticle; epi, epidermis; end, endodermis; par, parenchyma; per, pericycle; ph, phloem; pi, pith; tr, trichome; xy, xylem.
Jalapippali (Whole plant)
*Phyla nodiflora* Greene

Microscopic characters

Abbreviations: - col, collenchyma; lepi, lower epidermis; pal, palisade; ph, phloem; sm, spongy mesophyll; uepi, upper epidermis; vb, vascular bundle; xy, xylem.
Jalapippali (Whole plant)
*Phyla nodiflora* Greene

Powder characteristics

- **Unicellular trichomes**
- **T-shaped covering trichomes**
- **Collenchyma**
- **Stoma and epidermal cells**
- **Fibre**
Outline of a pharmacopoeial monograph on mineral and metal-based raw drugs

- Title-Official Ayurvedic name and English name
- Definition
- Synonyms, Sanskrit name/other languages
- Broad Classification
- Origin and Occurrence
- Physical Properties
- Chemical properties
- Assay of element metal
- Heavy metals and Arsenic
- Other elements (naturally appearing in the ore)
- Sodhana (purification/detoxification of material)
- Dose of Bhasma (calcinated material)
- Important formulations in which Bhasma is one of the ingredients
### Major Metals and Ores

<table>
<thead>
<tr>
<th>Number</th>
<th>Name</th>
<th>Type</th>
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<tbody>
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<td>1</td>
<td>Kanta Lauha</td>
<td>Iron Ore</td>
</tr>
<tr>
<td>2</td>
<td>Mandura</td>
<td>Iron Slag</td>
</tr>
<tr>
<td>3</td>
<td>Rajata</td>
<td>Silver Metal</td>
</tr>
<tr>
<td>4</td>
<td>Svarna</td>
<td>Gold Metal</td>
</tr>
<tr>
<td>5</td>
<td>Svarnamakshika</td>
<td>Chalcopyrite</td>
</tr>
<tr>
<td>6</td>
<td>Tamra</td>
<td>Copper Metal</td>
</tr>
<tr>
<td>7</td>
<td>Yashada</td>
<td>Zinc Metal</td>
</tr>
<tr>
<td>8</td>
<td>Banga</td>
<td>Tin Metal</td>
</tr>
<tr>
<td>9</td>
<td>Naga</td>
<td>Lead ore</td>
</tr>
<tr>
<td>No.</td>
<td>Mineral</td>
<td>Type</td>
</tr>
<tr>
<td>-----</td>
<td>-------------------------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>1.</td>
<td>Abharaka</td>
<td>Mica</td>
</tr>
<tr>
<td>2.</td>
<td>Gairika</td>
<td>Red Ochre</td>
</tr>
<tr>
<td>3.</td>
<td>Gandhaka</td>
<td>Sulphur</td>
</tr>
<tr>
<td>4.</td>
<td>Godanti</td>
<td>Gypsum</td>
</tr>
<tr>
<td>5.</td>
<td>Jawahararmohra</td>
<td>Serpentine</td>
</tr>
<tr>
<td>6.</td>
<td>Khatika</td>
<td>Kaolinite</td>
</tr>
<tr>
<td>7.</td>
<td>Tankana</td>
<td>Borax</td>
</tr>
<tr>
<td>8.</td>
<td>Saindhava Lavana</td>
<td>Rock Salt</td>
</tr>
</tbody>
</table>
Concept of Shodhana 
(Purification & Detoxification of the Raw Drugs)

Objects to ensure Safety:

1. To remove the non-desirous toxic effect of raw drugs.
2. To add additional properties to the drug.
3. To make the drug suitable as medicine
4. The purification is done by various processes of mixing, boiling of the raw drug with other substances with specific properties, Drying etc.
5. Juices/decoctions of various herbs etc. is used.
Bhasma/Incineration
Compounds of minerals & metals

- S.O.P. of Bhasma preparation

- Metals and minerals are converted in Micro-fine powder/Ash of various compounds like Oxides, Sulphides etc. These are herbo-metallic legends.

- This is archived by putting material on fire. One such cycle is called Puta

- The number of Puta required are according to nature of the Material (Heat-susceptibility) which may varies with metal from 30, 50, 100 upto 1000.

- Bhasma powders do not contain free metal in elemental form and the products are assimilable in human body quite safely.

  - Bhasmas & Rasaushadhies are fast acting potent medicines.

  - Pharmacopoeial standards of 21 Metals Minerals has been published
Concept of Bhasma and Rasaushadhasies (Herbo-metallic formulations)

Conversion of Metals – into Herbo-metallic legends by rigorous processing

- Purification of metals with different material by grinding and heating etc,
- Burning of Metals into ashes by Furnaces.
- Trituration of Metal ash with the juice of medicinal plants repeatedly
- Repeatedly burning into ashes 50-100 times
- Final product is free from elementary metal and suitable for medicinal purpose in a small dose as a compound formulation.
KĀNTA LAUHA
(Iron Ore)

- *Kānta Lauha* is an Iron ore containing magnetite, a ferric oxide (Fe₃O₄).
- **Broad Classification:** Oxide
- **Indications:** Anemia (Pandu), Colitis (Grahani), Rejuvenator (Rasayana)
### Physical properties:

<table>
<thead>
<tr>
<th>Nature</th>
<th>Lump</th>
<th>Lustre</th>
<th>Metallic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colour</td>
<td>Greyish black</td>
<td>Tenacity</td>
<td>Brittle</td>
</tr>
<tr>
<td>Streak</td>
<td>Reddish black</td>
<td>Transparency</td>
<td>Opaque</td>
</tr>
<tr>
<td>Cleavage</td>
<td>None</td>
<td>Hardness</td>
<td>5.5 to 6</td>
</tr>
<tr>
<td>Fracture</td>
<td>Uneven</td>
<td>Sp. Gr</td>
<td>5 to 6</td>
</tr>
<tr>
<td>Magnetism</td>
<td>Magnetic in nature</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Chemical Properties:

<table>
<thead>
<tr>
<th>Assay (Not less than)</th>
<th>60% Iron (Fe)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Heavy Metals &amp; Arsenic</strong> (Not more than)</td>
<td>Arsenic= 2 ppm</td>
</tr>
<tr>
<td>Other Elements may contain ± 20% of these limits</td>
<td>Zinc = 95 ppm</td>
</tr>
</tbody>
</table>
Kānta Lauha Shodhana (Iron) (Detoxification)

- Śodhana (Detoxification): Shall not be used in formulations without subjecting it to śodhana.
- Kānta Lauha is used in the form of bhasma in Herbo-Mineral formulation.
- Kantalauha-patra QS
- Taila (Seed oil of *Seasamum indicum*) QS nirvapana - 3 times
- Takra (Buttermilk from cow’s milk) QS nirvapana - 3 times
- Kanjika (Sour rice gruel) QS nirvapana - 3 times
- Gomutra (Cow urine) QS nirvapana - 3 times
- Kulattha-Kvatha QS nirvapana - 3 times

(Decoction of seeds of *Dolichos biflorus*)

Kanta Lauha is converted into Bhasma by putting on fire repeatedly (Puttas)
- The number of Putta required for Bhasma- 60

(Putta means repeated fire cycled to material)
SVARNAMĀKSIKA
(Chalcopyrite- Copper Ore)

- *Svarnamaksika* is a copper ore containing Chalcopyrite (CuFeS$_2$) mineral.
- **Broad classification**: Sulphide
- **Indications**: Rejuvenator (Rasayana), Beneficial for Male Reproductive System (Vrishya), Liver Disorders
### Physical Properties:

<table>
<thead>
<tr>
<th>Nature</th>
<th>Massive, smooth</th>
<th>Lustre</th>
<th>Metallic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colour</td>
<td>Golden yellow</td>
<td>Tenacity</td>
<td>Brittle</td>
</tr>
<tr>
<td>Streak</td>
<td>Greenish black</td>
<td>Transparency</td>
<td>Opaque</td>
</tr>
<tr>
<td>Fracture</td>
<td>Uneven</td>
<td>Hardness</td>
<td>3 to 4</td>
</tr>
<tr>
<td>Sp. Gr</td>
<td>3.4 to 3.7</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Chemical properties:

<table>
<thead>
<tr>
<th>Assay (Not less than)</th>
<th>5% Copper (Cu)</th>
<th>20% Iron</th>
<th>12% Sulphur</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heavy Metals &amp; Arsenic (Not more than)</td>
<td>Lead = 70 ppm (In built)</td>
<td>Arsenic = 1 ppm</td>
<td>Cadmium = 3 ppm</td>
</tr>
<tr>
<td>Other Elements may contain ± 20% of these limits</td>
<td>Gold = 0.70 ppm</td>
<td>Silver = 48 ppm</td>
<td>Zinc = 800 ppm</td>
</tr>
</tbody>
</table>
SVARNAMAKSHIKA SHODHANA
(Chalcopyrite- Copper Ore)
(Detoxification)

- **Śodhana (Detoxification):** Shall not be used in formulations without subjecting it to śodhana
- **Svarnamaksika** is used in the form of *bhasma* in Herbo-Mineral formulation.
- **Suvarna makshika** (Chalcopyrite)
- **Nimbuka svarasa** Q.S. for svedana (impregnation) (2-3 days)
  (Juice of fruits of Citrus limon)
- *The number of Putta required for Bhasma- 10 (Putta means repeated fire cycled to material)*
Multiple Ingredient Formulations

- Only herbal / plant based mixtures
- Only Metallic formulations (Bhasmas)
- Herbo-mineral / metallic formulations
- Herbo-mineral / metallic / animal by products based formulations
THE
AYURVEDIC
PHARMACOPOEIA
OF
INDIA

PART - II
VOLUME- II
First Edition
(FORMULATIONS)

GOVERNMENT OF INDIA
MINISTRY OF HEALTH AND FAMILY WELFARE
DEPARTMENT OF AYURVEDA, YOGA & NATUROPATHY, UNANI, SIDDHA
AND HOMOEOPATHY (AYUSH)
NEW DELHI
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. Twenty Laboratories & manufacturing companies are working on SOP’s
5. Pharmacopoeial Standards of 151 formulation have been published.
6. Annual Target is 50 formulations per year to cover 500 most widely used formulations.
<table>
<thead>
<tr>
<th>S.No</th>
<th>Dosage Form</th>
<th>No. of ingredients</th>
<th>Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Swarasa (Expressed Juice)</td>
<td>1-3</td>
<td>5-10 ml.</td>
</tr>
<tr>
<td>2.</td>
<td>Churna (Powder of the combination)</td>
<td>3-20</td>
<td>3-5 gm</td>
</tr>
<tr>
<td>3.</td>
<td>Kwath Churna (Coarse powder for making fresh decoction)</td>
<td>3-5 gm</td>
<td>10-30 gm</td>
</tr>
<tr>
<td>4.</td>
<td>Pravahi Kwath (Preserved decoction in liquid form - ready for use)</td>
<td>3-20</td>
<td>10-20 ml</td>
</tr>
<tr>
<td>5.</td>
<td>Asava and Arishta (Fermented liquids – multiple ingredients)</td>
<td>5-20</td>
<td>20-30 ml</td>
</tr>
<tr>
<td>6.</td>
<td>Arka (Distilled medicated water)</td>
<td>1-3</td>
<td>10-20 ml</td>
</tr>
<tr>
<td>7.</td>
<td>Avaleha (Jam like preparation)</td>
<td>10-50</td>
<td>5-10 gm</td>
</tr>
<tr>
<td>8.</td>
<td>Paka Khand (Confectionary like preparation)</td>
<td>10-25</td>
<td>5-10 gm</td>
</tr>
<tr>
<td>9.</td>
<td>Guggulu (<em>Commiphora witti</em> based preparation)</td>
<td>5-20</td>
<td>1-3 gm</td>
</tr>
<tr>
<td>10.</td>
<td>Ghrita (Clarified butter based preparation)</td>
<td>5-20</td>
<td>5-10 gm</td>
</tr>
<tr>
<td>No.</td>
<td>Description</td>
<td>Dose 1</td>
<td>Dose 2</td>
</tr>
<tr>
<td>-----</td>
<td>------------------------------------</td>
<td>--------</td>
<td>--------</td>
</tr>
<tr>
<td>11.</td>
<td>Taila (Medicated/oil based preparation)</td>
<td>10-20</td>
<td></td>
</tr>
<tr>
<td>12.</td>
<td>Lepa (For external applications)</td>
<td>5-15</td>
<td></td>
</tr>
<tr>
<td>13.</td>
<td>Malhara (Ointment)</td>
<td>3-5</td>
<td></td>
</tr>
<tr>
<td>14.</td>
<td>Satva/Ghansatva extracts</td>
<td>1-3</td>
<td>1/2 - 1 gm</td>
</tr>
<tr>
<td>15.</td>
<td>Vati/Gutika (tablet/pill)</td>
<td>5-20</td>
<td>1/2 - 1 gm.</td>
</tr>
<tr>
<td>16.</td>
<td>Panaka (syrups)</td>
<td>5-15</td>
<td>10-20 ml</td>
</tr>
<tr>
<td>17.</td>
<td>Capsules</td>
<td>5-10</td>
<td></td>
</tr>
<tr>
<td>18.</td>
<td>Aaschayotana (Eye drops)</td>
<td>3-5</td>
<td>2-3 drops</td>
</tr>
<tr>
<td>19.</td>
<td>Karn bindu (Ear drops)</td>
<td>5-10</td>
<td>2-6 drops</td>
</tr>
<tr>
<td>20.</td>
<td>Nasaya (Nasal drops/ insuflation)</td>
<td>5-10</td>
<td>2-4 drops</td>
</tr>
<tr>
<td>No.</td>
<td>Description</td>
<td>Quantity 1</td>
<td>Quantity 2</td>
</tr>
<tr>
<td>-----</td>
<td>-----------------------------------------------------------------------------</td>
<td>------------</td>
<td>------------</td>
</tr>
<tr>
<td>21.</td>
<td>Bhasma - <em>(Calcinated ash)</em>;</td>
<td>1-3</td>
<td>50-100 mg</td>
</tr>
<tr>
<td></td>
<td>(i) Mineral based ash</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(ii) Metal based ash</td>
<td></td>
<td></td>
</tr>
<tr>
<td>22.</td>
<td>Lauh &amp; Mandora <em>(Iron ash based formulations)</em>;</td>
<td>5-20</td>
<td>1 gm</td>
</tr>
<tr>
<td>23.</td>
<td>Ras Yoga</td>
<td>2-5</td>
<td>50-100 mg</td>
</tr>
<tr>
<td></td>
<td>(i) Kupipakva</td>
<td>2-5</td>
<td>30-60 mg</td>
</tr>
<tr>
<td></td>
<td>Rasayan &amp; Parpati - <em>(Special Metallic compounds with Sulphur)</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(ii) Rasayoga – <em>(Herbo-mineral metallic formulations)</em></td>
<td>5-20</td>
<td>125-250</td>
</tr>
</tbody>
</table>
## Srngyadi Curna

(3 ingredients)

<table>
<thead>
<tr>
<th></th>
<th>Ingredient</th>
<th>Scientific Name</th>
<th>Form</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Srngi (Karkata srngi)</td>
<td><em>Pistacia integerrima</em></td>
<td>Gl.</td>
<td>1 part</td>
</tr>
<tr>
<td>2</td>
<td>Prativisa</td>
<td><em>Aconitum palmatum</em></td>
<td>Rt. Tr.</td>
<td>1 part</td>
</tr>
<tr>
<td>3</td>
<td>Krsna (Pippali)</td>
<td><em>Piper longum</em></td>
<td>Fr.</td>
<td>1 part</td>
</tr>
</tbody>
</table>
TLC of Srngyādi Cūrna

Under UV 254 nm

1- Prativisa (Root) Alcoholic Extract
2- Pippali (Fruit) Alcoholic Extract
3- Sryngyagi Curna Alcoholic Extract
4- Srngi (Gall) Alcoholic Extract

Mobile Phase – Toluene: Ethyl acetate: Formic acid (5:4.5:0.5)
Under UV 366 nm

1- Prativisa (Root) Alcoholic Extract
2- Pippali (Fruit) Alcoholic Extract
3- Sryngyagi Curna Alcoholic Extract
4- Srngi (Gall) Alcoholic Extract

Mobile Phase – Toluene: Ethyl acetate: Formic acid (5:4.5:0.5)
Powder Microscopy of Srngyādi Cūrna
THIN LAYER CHROMATOGRAM OF
CHITRAKADI VATI (Tablet)

Tracks:

- $T_1$ – Ajamoda (*Apium graveolens*)
- $T_2$ – Pippali (*Piper longum*)
- $T_3$ – Chitraka (*Plumbago zeylanica*)
- $T_4$ – Chitrakadi vati (RRL, Bhu)
- $T_5$ – Chitrakadi Vati (Baidyanath)
- $T_6$ – Chavya (*Piper chaba*)
- $T_7$ – Sunthi (*Zingiber officinale*)
- $T_8$ – Pippali mula (*Piper longum* - Root)
- $T_9$ – Maricha (*Piper nigrum*)
- $T_{10}$ – Hingu (*Ferula assafoetida*)

Solvent System:

- $n$-Hexane : Acetone
  - 7.5 : 2.5

Visualisation:

- Anisaldehyde - Sulphuric acid Reagent
HPTLC Fingerprinting of Chitrakadi Vati (RRL, Bhu) at 254 nm
AROGYAVARDHINI VATI (Tablet)  
Herbo metallic Formulations

1. Rasa (parada) suddha (Mercury) 1/44 parts
2. Gandhaka-suddha (Sulphur) 1/44 parts
3. Lauha-bhasma (Iron) 1/44 parts
4. Abhra (abhraka)-bhasma (Mica) 1/44 parts
5. Sulva (tamra)-bhasma (Copper) 1/44 parts
6. Haritaki (Terminalia C) 2/44 parts
7. Bibhitaka (Terminalia B) 2/44 parts
8. Amalaki (Emblica officinalis) 2/44 parts
9. Silajatu-suddha (Asphaltum) 3/44 parts
10. Pura (guggulu) –suddha(Oleo raisin) 4/44 parts
11. Citra (Eranda) 4/44 parts
12. Tikta (Katuka) (Picorrhiza) 22/44 parts
13. Nimba vrksa dalambha (Neem leaves) QS
14. (nimba)-svarasa (Neem leaves juice)

One Tablet 250 mg. contains 4 mg. Hgs and daily dose will contain 8 mg of HgS. (Indications- Liver Disorders, Jaundice)
COMPLEXITY OF AYU DRUG STANDARDISATION

Multiple Ingredient

Various Process

Diversity in Raw Material

Desired Activity
Rationale of Poly-herbal formulation in Ayurveda

Drug-Body interaction

Multiple causes of disease require multiple target formulation
1. Molecules follow specific pathway and act on specific receptor.
2. In Disease condition, multiple organ systems are involved.
3. Therefore, drug should have a multiple targeted action.
4. Internal chemical involvement significantly varies from person to person.
5. Combination of different herbs targets the different site of action.
6. Therefore, Ayurveda has emphasized biological standardization considering the individual Psycho-somatic make-up.
7. Multiple ingredient formulation is the Strength of Ayurveda
Safety Studies
Issue of Heavy Metal Contamination in Herbal ASU Drugs

- Department of AYUSH has adopted Limits for heavy metal contamination in herbal ASU formulations as per WHO standards.

- Heavy metal estimation has been made mandatory for export of ASU herbal formulations.

- Data on 676 medicinal plants have been generated.

- A significant observation of the study is that washing of raw drug with potable water makes the material free from heavy metal contamination.
Safety study on Herbo-mineral Metal based Ayurveda formulations (Ras Aushadhis)

After the publication of JAMA Article, the safety studies of 8 Ras Aushadhis mentioned in the article were carried out in following top level research institutes of India

1. Indian Institute of Chemical Technology (IICT), Hyderabad
2. Central Drug Research Institute (CDRI), Lucknow.
3. Indian Institute of Integrated Medicine (Jammu)
Acute, sub-acute and chronic toxicity studies showed that the following medicines are absolutely safe:

1. Siddha Makaradhwaj with gold.
2. Maha Lakshmi vilas Ras
3. Maha Yograj Guggulu (with gold)
4. Arogyavardhini Vati
5. Rasamanikya (Arsenic compound)
6. Kajjali (HgS)
7. Vasant Kusumakar Ras
8. Ras Sindur

90 days chronic study has also revealed that these compound Ayurvedic formulations are fully safe on scientific parameters.
Efficacy Studies under GTP Project
(AYUSH-CCRAS, CSIR & ICMR collaboration)

• Following 07 diseases have been undertaken for Clinical Trials:

1. Benign Prostate Hypertrophy
2. Osteoporosis
3. Hypertension
4. Dyslipidemia
5. Anxiety neurosis
6. Oligospermia
7. HIV/AIDS
Standardization, safety studies under GTP Project

- The status of Standardization, safety studies of 9 Ayurvedic formulations:

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Formulation</th>
<th>Standardization</th>
<th>Safety studies</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Tagradi Kwatha</td>
<td>Completed</td>
<td>Completed</td>
</tr>
<tr>
<td>2.</td>
<td>Medhya -6</td>
<td>Completed</td>
<td>Completed</td>
</tr>
<tr>
<td>3.</td>
<td>Ashwagandha Churna</td>
<td>Completed</td>
<td>Completed</td>
</tr>
<tr>
<td>4.</td>
<td>Haritakyadi Churna</td>
<td>Completed</td>
<td>Completed</td>
</tr>
<tr>
<td>5.</td>
<td>Lakshadi Guggulu</td>
<td>Completed</td>
<td>Completed</td>
</tr>
<tr>
<td>6.</td>
<td>Gokshuradi guggulu</td>
<td>Completed</td>
<td>Completed</td>
</tr>
<tr>
<td>7.</td>
<td>Brahmi Ghrita</td>
<td>Completed</td>
<td>Completed</td>
</tr>
<tr>
<td>8.</td>
<td>Singhanada Guggulu</td>
<td>Completed</td>
<td>Completed</td>
</tr>
<tr>
<td>9.</td>
<td>Nirgundi taila</td>
<td>Completed</td>
<td>Completed</td>
</tr>
</tbody>
</table>

Multicentric Clinical Trials ready for being started
Efficacy Studies
Efficacy Studies on Classical Ayurvedic Formulations
(under Ayurvedic Pharmacopoea Committee project)

- New initiative by Dept. of AYUSH through Ayurvedic Pharmacopoeia Committee.
- Multicentric Studies on uniform standardized protocol on identified conditions at M.D. (Ayu) & Ph. D. level
- Trial drug supply on Pharmacopoeial standards
- Monitoring by Central Council for Research in Ayurveda & Siddha
- Data on 100 formulations is targeted initially
A New Initiative
Preparation of Registration Dossier for EU/USFDA

• Scientific work has been started to develop couple of dossiers of commonly used Ayurvedic medicines:

1. **Ashwagandha Churna** (Powder)

2. **Triphala Churna** (Powder) - with three ingredients (*Terminalia chebula, Terminalia bellerica, Embellica officinalis*)
New Initiatives of Govt. of India relating Quality Assurance of Ayurveda Medicines

1. G.M.P is mandatory for Manufacturing of Ayurvedic Medicines. Indian companies are being supported to upgrade to EU/US FDA-GMP Guidelines.


3. NABL Accreditation of Ayurvedic Drug Testing Labs and Laboratories are also being supported to comply with G.L.P requirements.
Quality Council of India has been engaged for this Endeavour

- **Scheme for Voluntary certification of ASU products** like
  - Chyawanprash Avleha (Paste)
  - Triphala Churna (Powder)
  - Ashwagandha Churna (Powder)
  - Chandraprabha Vati (Tablet)

- The fast moving *Quality ASU products* shall have Logo of **AYUSH Standard** for domestic and **AYUSH Premium** for international market

  The scheme has been launched on 1\textsuperscript{st} Oct. 2009
National Accreditation

- NABL Accreditation of AYUSH Drug Testing Laboratories
- NABH accreditation of AYUSH Hospitals & Panchakarma Centers
- Accreditation of AYUSH Teaching Institutions
Woods are Lovely Dark & Deep

But

I have Yet Promises to Keep

And

Miles to Go Ahead Before I Sleep

No More Never More

Robert Frost
THANKS
### Comparative Data on Heavy Metal Analysis on Raw Drugs

<table>
<thead>
<tr>
<th>Sanskrit name</th>
<th>Botanical name</th>
<th>Place of collection</th>
<th>Lead</th>
<th>Cadmium</th>
<th>Arsenic</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sanskrit name</strong></td>
<td><strong>Botanical name</strong></td>
<td><strong>Place of collection</strong></td>
<td><strong>Lead</strong> (SRIRAM)</td>
<td><strong>Cadmium</strong> (SRIRAM)</td>
<td><strong>Arsenic</strong> (SRIRAM)</td>
</tr>
<tr>
<td>Vaca (Root)</td>
<td>Acorus calamus Linn.</td>
<td>Tarikhet</td>
<td>0.608</td>
<td>0.028</td>
<td>0.254</td>
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<tr>
<td>Vaca (Root)</td>
<td>Acorus calamus Linn.</td>
<td>Itanagar</td>
<td>0.863</td>
<td>0.033</td>
<td>0.033</td>
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<tr>
<td>Vasa (Leaf)</td>
<td>Adhatoda vasic Nees</td>
<td>Itanagar</td>
<td>0.625</td>
<td>0.095</td>
<td>0.078</td>
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<tr>
<td>Vasa (Leaf)</td>
<td>Adhatoda vasic Nees</td>
<td>Tiruvananthapuram</td>
<td>0.523</td>
<td>0.01</td>
<td>0.03</td>
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<tr>
<td>Vasa (Leaf)</td>
<td>Adhatoda vasic Nees</td>
<td>Jhansi</td>
<td>0.544</td>
<td>0.022</td>
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<tr>
<td>Vasa (Leaf)</td>
<td>Adhatoda vasic Nees</td>
<td>Uttarakhand</td>
<td>2.125</td>
<td>0.032</td>
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<tr>
<td>Sirisa (Stem Bark)</td>
<td>Albizia lebbek Benth.</td>
<td>Jhansi</td>
<td>1.608</td>
<td>0.02</td>
<td>ND</td>
</tr>
<tr>
<td>Sirisa (Stem Bark)</td>
<td>Albizia lebbek Benth.</td>
<td>Itanagar</td>
<td>0.874</td>
<td>0.038</td>
<td>0.046</td>
</tr>
<tr>
<td>Sirisa (Stem Bark)</td>
<td>Albizia lebbek Benth.</td>
<td>Gwalior</td>
<td>0.607</td>
<td>0.037</td>
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<tr>
<td>Palandu (Bulb)</td>
<td>Allium cepa Linn.</td>
<td>Gwalior</td>
<td>0.673</td>
<td>0.045</td>
<td>0.039</td>
</tr>
<tr>
<td>Palandu (Bulb)</td>
<td>Allium cepa Linn.</td>
<td>Itanagar</td>
<td>0.435</td>
<td>ND</td>
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<tr>
<td>Lasuna (Bulb)</td>
<td>Allium sativum Linn.</td>
<td>Itanagar</td>
<td>0.961</td>
<td>ND</td>
<td>0.023</td>
</tr>
<tr>
<td>Nimba (Seed)</td>
<td>Azadirachta indica A. Juss.</td>
<td>Gwalior</td>
<td>1.402</td>
<td>0.074</td>
<td>0.049</td>
</tr>
<tr>
<td>Nimba (Seed)</td>
<td>Azadirachta indica A. Juss.</td>
<td>Jhansi</td>
<td>0.23</td>
<td>0.058</td>
<td>0.025</td>
</tr>
<tr>
<td>Nimba (Flower)</td>
<td>Azadirachta indica A. Juss.</td>
<td>Gwalior</td>
<td>5.019</td>
<td>0.181</td>
<td>0.101</td>
</tr>
<tr>
<td>Nimba (Flower)</td>
<td>Azadirachta indica A. Juss.</td>
<td>Jhansi</td>
<td>0.23</td>
<td>0.058</td>
<td>0.025</td>
</tr>
<tr>
<td>Nimba (Flower)</td>
<td>Azadirachta indica A. Juss.</td>
<td>Gwalior</td>
<td>0.966</td>
<td>0.045</td>
<td>0.091</td>
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<td>Nimba (Fruit)</td>
<td>Azadirachta indica A. Juss.</td>
<td>Jhansi</td>
<td>0.248</td>
<td>0.057</td>
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<tr>
<td>Nimba (Leaf)</td>
<td>Azadirachta indica A. Juss.</td>
<td>Itanagar</td>
<td>0.496</td>
<td>0.059</td>
<td>0.106</td>
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<tr>
<td>Nimba (Leaf)</td>
<td>Azadirachta indica A. Juss.</td>
<td>Gwalior</td>
<td>1.949</td>
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<td>0.031</td>
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<tr>
<td>Nimba (Leaf)</td>
<td>Azadirachta indica A. Juss.</td>
<td>Jhansi</td>
<td>0.499</td>
<td>0.018</td>
<td>0.024</td>
</tr>
<tr>
<td>Nimba (Root bark)</td>
<td>Azadirachta indica A. Juss.</td>
<td>Gwalior</td>
<td>0.177</td>
<td>0.097</td>
<td>0.018</td>
</tr>
<tr>
<td>Nimba (Root bark)</td>
<td>Azadirachta indica A. Juss.</td>
<td>Itanagar</td>
<td>0.497</td>
<td>0.093</td>
<td>0.085</td>
</tr>
<tr>
<td>Nimba (Stem bark)</td>
<td>Azadirachta indica A. Juss.</td>
<td>Gwalior</td>
<td>0.173</td>
<td>0.069</td>
<td>0.019</td>
</tr>
<tr>
<td>Nimba (Stem bark)</td>
<td>Azadirachta indica A. Juss.</td>
<td>Itanagar</td>
<td>0.54</td>
<td>0.101</td>
<td>0.048</td>
</tr>
<tr>
<td>Nimba (Stem bark)</td>
<td>Azadirachta indica A. Juss.</td>
<td>Pune</td>
<td>0.559</td>
<td>0.056</td>
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<tr>
<td>Guggulu-bheda (Leaf)</td>
<td>Balsamodendron audate Mauch.</td>
<td>Tiruvananthapuram</td>
<td>2.421</td>
<td>0.048</td>
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</table>

**Requirement as per WHO**

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