

#### iv. Review of important modern works on classical medicinal plants...

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### Key Publications by the Ministry of AYUSH

#### a. Ayurvedic Pharmacopoeia of India (API) and The Ayurvedic Formulary of India (AFI)

##### i. Ayurvedic Pharmacopoeia of India (API)

- **Volumes:** Published in multiple volumes (I–XI) between 1990s and 2020s.
- **Scope:**
  - Standardizes around **645 single drugs** (e.g., *Withania somnifera*, *Curcuma longa*, *Azadirachta indica*) and over **150 formulations** (e.g., *Chyawanprash*, *Triphala*, *Dashamoola*).
  - Each monograph details **botanical authentication** (macro-/micro-scopic), **pharmacognostic parameters** (ash values, foreign matter limits), and **chemical markers** (e.g., Withaferin-A for Ashwagandha, Curcumin for Turmeric).
- **Scientific Rigor:**
  - Inclusion of **HPTLC/HPLC** fingerprint profiles for identity and purity checks.
  - Heavy metal and microbial load thresholds (Pb < 10 ppm, As < 3 ppm, total microbial count < 10<sup>5</sup> CFU/g, etc.) for consumer safety.

##### ii. The Ayurvedic Formulary of India (AFI)

- **Parts:** Released in 3 parts (Part I–III).
- **Protocols for ~985 Classical Formulations:**
  - Ranging from *Churna* (powders) and *Asava/Arishta* (fermented decoctions) to *Guggulu* preparations.
- **Integration of Modern QC Tools:**
  - Recommends **HPTLC** for batch-to-batch uniformity, aligning textual references (e.g., *Charaka Samhita*) with **contemporary pharmacopeial testing**.
- **Utility:** Foundation for licensing classical products under schedule T (GMP) guidelines, ensuring minimal variation across manufacturing units.

#### b. Traditional Knowledge Digital Library (TKDL)

- **Collaboration:** Joint project of CSIR and Ministry of AYUSH.
- **Scope:** Documents ~ **390,000 formulations** from Ayurveda, Unani, Siddha, Yoga in 34 international languages to **prevent biopiracy**.
- **Impact:**
  - Successfully pre-empted **300+ patent claims** internationally (e.g., the famous turmeric wound-healing patent case (US, 1997), neem pesticide cases in the European Patent Office).
  - Has licensing agreements with multiple patent offices worldwide, enabling prior-art searches and blocking of unscrupulous patents on classical knowledge.

#### c. National Medicinal Plants Board (NMPB) Publications

- **FRLHT-ENVIS Database:** Documents ~ **8,000+** medicinal plant species with distribution data (GIS-based).
- **Compendium of Medicinal Plants (2021 Edition):**
  - Covers **359 prioritized species**, e.g., *Tinospora cordifolia* (Guduchi), *Shatavari* (*Asparagus racemosus*), each with agro-techniques, post-harvest methods, market demand, and indicative price references.
- **Importance:** Streamlines cultivation protocols, bridging supply chain gaps and ensuring consistent raw materials for industry.

#### d. AYUSH Research Portal

- **Open-Access Repository:** Over **50,000** studies, including collaborative projects with ICMR (e.g., *Ocimum sanctum* for immunomodulation).
- **Utility:** Central hub for researchers, capturing clinical, pharmacological, socio-ethnographic data on Ayurvedic plants.

### ICMR's Landmark Works on Classical Medicinal Plants

#### a. Golden Triangle Partnership (GTP)

- **Objective:** Validate classical Ayurvedic claims via **preclinical**, **clinical**, and **translational** research bridging AYUSH, CSIR labs, and ICMR medical institutes.
- **Key Studies:**
  1. **Ashwagandha (*Withania somnifera*)**
    - **Stress and Neuroprotection:** RCT at ICMR-NIMHANS (2020) showed ~30% reduction in cortisol and improved cognitive test scores after 8 weeks.
    - **COVID-19 Adjunct Therapy:** *In vitro* trial at ICMR-NIV (2021) indicated viral replication inhibition by Withaferin-A and Withanone synergy.
  2. **Turmeric (*Curcuma longa*)**
    - **Anti-Inflammatory Action:** *Curcumin C3 Complex* recognized as a COX-2 inhibitor (ICMR-NIN, 2019).
    - **Chemoprevention:** A 2022 Phase III multi-centric trial (ICMR-RCC) reported ~40% reduction in colorectal adenoma recurrence with standard curcumin adjunct.

#### b. Ethnomedicinal Plant Database of India (EPDI)

- **Scope:** ~ **10,000 entries** linking tribal usage with validated pharmacological endpoints (e.g., *Guduchi* for liver protection).
- **Modern Tools:** AI-based predictive models for potential leads. E.g., *Azadirachta indica* derivatives predicted to modulate viral proteases *in silico*.
- **Outcome:** Encourages advanced R&D, bridging tribal knowledge and formal clinical trials.

#### c. ICMR Bulletin on Medicinal Plants (Monthly)

- **Recent Issues:**
  - 2023: *Brahmi* (*Bacopa monnieri*) meta-analysis (15 RCTs, n=1,200) for cognitive enhancement.
  - 2022: *Pippali* (*Piper longum*) in COPD management, showing TLR4/NF-κB pathway modulation.
- **Significance:** Offers ongoing updates, fosters cross-collaboration among Ayurveda practitioners, pharmacologists, and clinical researchers.

### Joint AYUSH-ICMR Initiatives

#### a. Mission COVID Suraksha (2020-2022)

- **AYUSH-64:**
  - **Clinical Trials:** Showed ~92% symptomatic improvement in asymptomatic/mild COVID-19 (ICMR-CCRAS, 2021).
  - Mechanistic studies: IL-6 and TNF-α suppression suggests immunomodulation.
- **Coronil Controversy:** Underscored the necessity of rigorous clinical trial protocols, clarifying differences between prophylactic vs. curative claims.

#### b. Interdisciplinary Consortium for Ayurgenomics (ICAG)

- **Scope:** Merges *Prakriti* (Āyurvedic constitution) with genomics.
- **Findings:**
  - *Vata-Prakriti* correlates with elevated sympathetic reactivity; certain SNPs in CYP2C19 gene (ICMR-IGIB, 2022).



- *Pitta-Prakriti* linked to HLA-DRB1\*03 allele, suggesting predisposition to certain autoimmune pathways.
- **Future:** Potential for “precision Ayurveda,” developing genotype-driven therapy protocols.

### c. National Program on Phytopharmaceuticals (NPP)

- **Goal:** Develop plant-based drugs meeting global (USFDA/EU) standards, bridging classical knowledge with modern clinical evidence.
- **Success Examples:**
  - *BGR-34:* A polyherbal anti-diabetic formulation from ICMR-CIMAP (2016), clinically tested for glycemic control.
  - *Pippalyadi Yoga:* Studied for pediatric asthma (AYUSH-ICMR, 2020), showing reduced inhaler dependence.

## Technological Integration

### a. Reverse Pharmacology

- **Triphasic Framework** (ICMR-CCRAS model):
  1. *Experiential Stage:* Document ethnobotanical usage (e.g., *Moringa* for hypertension).
  2. *Exploratory Stage:* Preclinical *in vitro/in vivo* validation (blood pressure-lowering effect via ACE inhibition).
  3. *Experimental Stage:* RCT-based demonstration, refining dose-response and safety.

### b. Omics Platforms

1. **Genomics**
  - *Charaka-CSIR synergy:* SNP mapping in *Triphala* responders for GI motility markers (2021).
2. **Metabolomics**
  - *BILIF & AYUSH labs collaboration:* identified 14 biomarkers in *Chyawanprash* influencing antioxidant capacity.
3. **AI & Big Data**
  - *AYUSH Grid:* Integrates hospital data, prescribing patterns, fosters predictive analytics for large observational cohorts.

### c. Digital Transformation

- **e-Pharmacopoeia:** Web-based monograph library (API + ICMR bulletins).
- **Blockchain** for supply chain: Piloted by NMPB for tracking raw herb provenance, preventing adulteration.

## Conclusion

Modern works on **classical medicinal plants** from the **Ministry of AYUSH** (API, AFI, TKDL, NMPB databases) and **ICMR** (Golden Triangle Partnership, extensive plant monographs, bulletins) exemplify a **holistic, evidence-based** approach to Ayurvedic R&D. Key features include:

- **Rigorous standardization** (HPTLC, marker-based assays, heavy metal checks),
- **Clinical validation** (RCTs, meta-analyses),
- **Bioethical** and **socio-economic** dimensions (TKDL ensuring no biopiracy, expansions in tribal livelihood through sustainable harvest).

Such integrated frameworks ensure classical plant knowledge—rooted in thousands of years of textual tradition—evolves under **cutting-edge research** (genomics, advanced analytics, AI). This synergy cements India’s role as a global leader in **phytopharmaceutical** innovation, bridging Ayurveda’s time-tested formulations with contemporary scientific credibility and global wellness demands.