WORLD JOURNAL OF PHARMACEUTICAL RESEARCH
Coden USA: WJPRAP Impact Factor 8.63
Volume 15, Issue 21, 1464-1477. Review Article ISSN 2277–7105

DEVELOPMENT OF AYURVEDIC NEUTRACEUTICALS, ITS GLOBAL STANDARDS AND CHALLENGES W.S.R. TO AYURVEDIC PHYTOPHARMACEUTICALS

[*1]Dr. Disha Dinesh Devadiga, [2]Dr. Surekha S. Medikeri

[1]PG Scholar, Dept. of PG and PhD Studies in Rasashastra and Bhaishajya Kalpana, Government Ayurveda Medical College, Bengaluru.

[2]HOD and Principal, Dept. of PG and PhD Studies in Rasashastra and Baijya Kalpana, Government Ayurveda Medical College, Bengaluru.

Article Received on 05 Oct. 2026,
Article Revised on 25 Oct. 2026,
Article Published on 01 Nov. 2026,
https://doi.org/10.5281/zenodo.23910678

***Corresponding Author**
Dr. Disha Dinesh Devadiga
PG Scholar, Dept. of PG and PhD Studies in Rasashastra and Bhaishajya Kalpana, Government Ayurveda Medical College, Bengaluru.

How to cite this Article: [*1]Dr. Disha Dinesh Devadiga, [2]Dr. Surekha S. Medikeri (2026). Development Of Ayurvedic Neutraceuticals, Its Global Standards And Challenges W.S.R. To Ayurvedic Phytopharmaceuticals. World Journal of Pharmaceutical Research, 15(21), 1464–1477.
This work is licensed under Creative Commons Attribution 4.0 International license.

ABSTRACT

The rise of lifestyle diseases has increased interest in natural, food based health solutions. Ayurvedic nutraceutical products are based on traditional Ayurvedic principle which aims to support digestion, immunity, mental clarity, and overall wellness. Developing these products combines traditional knowledge with modern quality checks to ensure safety and effectiveness. While classical forms are potent, they can be challenging in terms of palatability, stability and global acceptance. Modern adaptations to modify the dosage forms and making them into ready to use forms improve taste, convenience, and daily use. Efforts to standardize ingredients, test for contaminants and ensure consistent quality help meet global safety standards. Government programs and research initiatives support product development, training, and international promotion. By blending time tested Ayurvedic wisdom with modern practices, these nutraceuticals offer safe, practical, and globally acceptable options for preventive health and overall well being.

INTRODUCTION

Dietary health has become a major global concern as non communicable diseases (NCDs) continue to rise, mainly due to improper eating habits and nutrient deficient diets. According

to recent WHO estimates nearly 41 million deaths[1] per year globally are due to NCDs, that is roughly 71% of all global deaths which are linked to poor dietary practices, highlighting the urgent need for nutritional awareness and preventive strategies. As demand increases for food based solutions for health maintenance, This shift toward wholesome, natural foods has accelerated interest in nutraceuticals bioactive food components that offer therapeutic or disease preventive benefits.

Nutraceuticals are health enhancing products derived from herbal or natural bioactive compounds that offer nutritional as well as therapeutic benefits.[2] They are classified into Traditional Neutraceuticals and Non Traditional Neutraceuticals, functional foods, dietary supplements, Medical foods and probiotic or fortified formulations. Nutraceuticals aim to prevent disease, improve physiological functions, and promote overall wellness.

Their convergence with Ayurvedic science, which is one of the world's oldest holistic health systems, is increasingly recognized Pathya Ahara, Dinacharya, Ritu Charya, Agni regulation, Dosha balance, dhatu poshana, Ojas enhancement, Rasayana therapies.[3] Unlike conventional supplements that focus on isolated nutrients, Ayurvedic nutraceuticals emphasize in nurturing digestion, immunity, mental clarity and vitality through synergistic formulations. These time tested remedies are gaining global attention for their gentle yet effective approach. In the current time Ayurvedic nutraceuticals stand at the intersection of ancient tradition and contemporary well being.

Drastic global demand for herbal medicines has also raised issues regarding safety and efficacy. A new drug category designed by Govt of India called "Phytopharmaceuticals[4]" are scientifically validated, plant derived medicinal products that bridge traditional herbal knowledge with modern drug development. Unlike conventional herbal remedies, phytopharmaceuticals undergo standardized extraction, rigorous characterization of bioactive compounds, and clinical evaluation to ensure quality, safety, and efficacy. They represent a growing category in evidence based natural medicine, offering therapeutic options rooted in botanical resources yet supported by contemporary research. Their development highlights the convergence of nature and science in addressing modern health needs.

CRITERIAS FOR DEVELOPMENT OF AYURVEDIC NEUTRACEUTICAL PRODUCTS

SELECTION OF RAW MATERIALS

Identification and authentication of plant materials are essential to prevent adulteration and ensure nutraceutical quality. Key methods include macromorphology, which examines visible features such as roots, stems, leaves, flowers, and fruits, and microscopy, which identifies microscopic traits like hairs, crystals, and specialized cells.[5] Phytochemical characteristics are assessed through chemical fingerprinting using techniques like TLC (Thin Layered Chromatography), HPTLC (High-Performance Thin Layered Chromatography and HPLC (High-Performance Liquid Chromatography) to document marker compounds. DNA sequencing and DNA barcoding provide precise species identification based on unique genetic markers unaffected by environmental factors.[6] Metabolite profiling and metabolomics further support quality control by identifying and comparing metabolites using MS (Mass Spectrometry), NMR (Nuclear Magnetic Resonance), and GC-MS (Gas Chromatography and Mass Spectrometry). In Ayurveda, drug selection also emphasizes Prakriti (constitution), Rasa, Guna, Virya, Vipaka, and karma (therapeutic action), along with seasonal and regional suitability to ensure optimal efficacy.[7] Combining classical Ayurvedic criteria with modern tools strengthens quality control, supports accurate marker compound identification, and ensures safe, effective herbal and nutraceutical preparations.

EASE IN PRODUCT DEVELOPMENT

Ayurveda comprises of wide range of herbal formulations which include diverse dosage forms such as churna, svarasa, kashaya, asava, arishta, ghrita, lehya and taila, valued for their affordability and accessibility. Traditionally, practitioners prepared medicines at home, a practice still seen in specialized family lineages. However, household level production cannot meet global demand. Industrialization began in the 20th century with Arya Vaidya Sala, Kottakkal, Himalaya and today India hosts over 9,000 Ayurvedic drug manufacturing units. Many processes remain direct mechanizations of traditional methods, often resulting in labor intensive production. Integrating traditional techniques with modern processing principles could improve scalability, efficiency, and raw material utilization. Correlating traditional methods of prepartions with modern biopharmaceutical processes like pounding/mashing, hot solvent extraction, maceration, pressurized liquid extraction, microwave assisted extraction, ultrasound assisted extraction, supercritical fluid extraction, solid phase extraction, reflux and fermentation can ease the advancements in Ayurvedic product manufacturing. Hima illustrates this connection, it uses solvent extraction without heat, preserving volatile compounds. By using modern techniques like agitation or pressurized liquid extraction, one

can facilitate large scale manufacture.[9] These modern technology and machinery can improve the precision, hygiene and efficiency in production.

READY TO CONSUME FORM/ REASONABLE PALATABILITY

Classical preparations such as Lajamanda Peya, Vilepi, Yusha, and Yavagu are classified based on consistency and mode of intake Ashitha (eaten), Peetha (drunk), Khadita (chewed), and Leedha (licked)[9], to optimize digestibility and therapeutic efficacy. These formulations serve multiple purposes, Shodhana (purification) as in Trivrit Leha, Shamana (palliative) like Yavakoladi Yavagu, Laja Yavagu[10] and Pathya/ Saṃsarjana for recovery. While traditional preparations are potent, they are often limited by short shelf life, bitterness, dosing variability, and daily preparation requirements. Modern adaptations have transformed these classical remedies into convenient, palatable, and standardized forms, such as immunity-boosting gummies with Giloy, Ashwagandha gummies marketed by Vaidyaratnam. Golden milk/ Turmeric latte mix by UMA Ayurveda Pharmacy. Herbal candies/ Lozenges with Tulsi, Mulethi, Amla,Ginger by Dabur, Himalaya. Chyawanprash infused cookies, chocolates, and functional bars with Moringa, Ashwagandha, as well as ready to drink shots and juices. Contemporary formulations also target general wellness and specific needs, such as combining multivitamins with Ashwagandha, Tulsi, and Guduchi for immunity and stress relief, or pairing Inorganic mineral supplements such as calcium, vitamin D3, collagen peptides, and herbs like Cissus quadrangularis and Boswellia to support bone and joint health. Zandu Shilajit Caps by Emami Group, Multivitamin for women that includes mineral like iron and folate alongside with herbal extracts. These innovations enhance usability, compliance, and acceptability, bridging classical Ayurvedic wisdom with modern lifestyles

THERAPEUTIC POTENTIAL

Ayurvedic Pharmaceutics emphasizes on principals like samyoga (Combination), Vishlesha (Removal), Kaala (Timing), Samskara (Processing) etc to increase or decrease efficacy in line with patients needs. Advanced Formulation Techniques can improve solubility, gut stability, absorption and optimize the therapeutic potential. Few such strategies include Nano formulations that increase solubility and protect the bioactive against degradation. Usage of Lipiodal and Encapsulation techniques provide controlled release and enhance uptake of both hydrophilic and lipiphilic compounds. Use of Bioenhancer like piperine[11] can increase the bioavailability of nutrients like Beta caratone, vitamins and phytochemicals. Synergestic combinations, Phytosome technology, complexation and co delivery system can improve

activity by exploiting synergestic interactions between bioactives. Personalised dosing considering age, disease status, drug interaction and nutritional status to choose right dose and interval.

	DRUG	CHALLENGES	ADVANCEMENT	BENIFIT
1.	Haridra[12]	Poor water solubility→Low Absorption	Curcumin + Piperine	Piperine acts as bioenhancer → Increase Bioavailability
			Liposomal Curcumin	Encapsulation improves stability and cellular uptake
			Nano-curcumin	Faster solubility and better absorption
2.	Ashwagandha[13]	Poor solubility of Active withanolides	Standardised Extracts eg. KSM-66 Nanoparticle Ashwagandha	Increased brain penetration→ Improved neuroprotective and anti-stress effects
3.	Triphala	Polyphenols have low absorption and stability	Phytosome Formulation	When complexed with phospholipids it improves the bioavailabilty
			Nono emulsion	Portects from GI Degradation
4.	Guggulu[14]	Poor solubility of guggulusterone→Low absorption	Self emulsifying drug delivery system (SEDDS)	Better lipid lowering and anti inflammatory potential

GLOBAL CHALLENGES

TOXICITY AND SAFETY TO MEET REGULATORY GUIDELINES

Ensuring toxicity evaluation and safety assurance is a critical requirement for the global export of Ayurveda based nutraceuticals, as international markets demand strong scientific evidence of quality, safety, and efficacy. Although Ayurvedic formulations are traditionally considered safe due to their natural origin and long history of use. Variability in raw materials, differences in cultivation practices, improper processing, and contamination with heavy metals, pesticides, or microbes can pose potential health risks. International guidelines such as those from WHO, US FDA, EFSA, and EMA require adherence to Good Manufacturing Practices (GMP), Good Agricultural and Collection Practices (GACP), and rigid quality control measures. Safety evaluation also includes assessment of herb drug interactions, allergenicity, and long-term consumption risks, which are particularly important for nutraceuticals intended for daily use.

Significant challenge arises from environmental contamination. Medicinal plants used in nutraceuticals may absorb heavy metals from polluted soil, water, or air, especially in regions affected by industrial activities or excessive agrochemical use. This leads to unintentional

metal contamination even in purely herbal products. Ayurvedic nutraceuticals often face challenges related to metal toxicity and safety due to one major reason is the use of herbo mineral formulations (Rasaushadhis), which intentionally include metals such as mercury, lead, arsenic, iron, and copper. In classical Ayurveda, these metals are subjected to elaborate purification and processing methods (Shodhana and Marana) to reduce toxicity and enhance therapeutic benefits.

From a global perspective, strict international regulations impose very low permissible limits for heavy metals. Products that meet traditional standards may still fail to comply with international safety norms, creating export barriers.

Heavy Metal PPM Limits for Ayurvedic Products.[15b]

METALS	WHO	INDIA	EUROPEAN UNION	UNITED KINGDOM	SOUTH AFRICA
Lead(Pb)	10	10	3	3	10
Cadmium (Cd)	0.3	0.3	1	1	0.3
Arsenic(As)	10	3	1	1	5
Mercury(Hg)	1	1	0.1	0.1	0.5
Regulatory Body	WHO	AYUSH	EU REG	FSA/MHRA	MCC

METALS	CHINA	JAPAN	AUSTRALIA	CANADA	SINGAPORE
Lead(Pb)	10	10	5	10	10
Cadmium (Cd)	1.0	0.3	0.2	0.3	0.3
Arsenic(As)	2	2	1	5	5
Mercury(Hg)	0.5	0.2	0.1	0.2	0.5
Regulatory Body	Chinese pharmacopia	Japanese Pharmaopia	TGA	Health Canada	HSA

QUALITY ISSUES/ADULTRATION

Medicinal plants used in Ayurvedic nutraceuticals often show wide variation in their chemical composition due to differences in geographical origin, soil quality, climate, harvesting time, and post harvest handling, lead to variable efficacy and make it difficult to ensure batch to batch uniformity, which is a key requirement for global trade. Another serious concern is adulteration, which may be intentional or accidental. Intentional adulteration is often driven by economic motives, such as substituting expensive herbs with cheaper plant materials or synthetic compounds. For example, studies have reported the adulteration of Ashwagandha[16] products with other Withania species or unrelated roots, reducing therapeutic value. Similarly, Brahmi (Bacopa monnieri) formulations have been found adulterated with Centella asiatica, Shankhapushpi (Convolvulus pluricaulis) often adulterated

with Clitoria ternatea or other creeping vines because of morphological similarity. Some commercial formulations of Triphala have been reported to contain fillers such as powdered starch, sugar, or other low cost plant materials to increase bulk. Turmeric (Curcuma longa) powders in some cases have been adulterated with lead chromate or other coloring agents to enhance the bright yellow appearance, posing serious toxicity risks.

Guggulu (Commiphora mukul) supplements are occasionally adulterated with other gum resins or plant exudates to cut costs, affecting anti inflammatory efficacy.

Accidental adulteration and contamination also pose significant challenges. These may occur due to misidentification of plant species, poor storage conditions, or contamination with heavy metals, pesticides, and microbes. Addressing these challenges requires strict standardization, advanced analytical authentication methods, transparent supply chains, and stronger regulatory oversight. Integrating traditional Ayurvedic knowledge with modern quality science is essential to build global trust and ensure sustainable international growth.

DEVELOPMENT OF EFFECTIVE MARKER

A chemical marker in herbal medicine refers to a compound that can be reliably measured to indicate the identity, purity, and strength of a product. Unlike conventional drugs, Ayurvedic formulations are often complex mixtures of multiple herbs with many bioactive constituents, making standardization inherently difficult. In traditional practice, therapeutic benefits emerge from the synergistic action rather than a single "active ingredient." This poses a central challenge for marker development because isolating one or a few compounds may not fully represent the formulation's overall therapeutic potential.

Advanced multi component fingerprinting techniques such as High-Performance Thin-Layer Chromatography (HPTLC), Liquid Chromatography Mass Spectrometry (LC-MS), and Nuclear Magnetic Resonance (NMR) are increasingly used to create detailed chemical profiles reflecting the true composition of these products.

Another challenge is the selection of appropriate markers. Regulatory sources such as the Ayurvedic Pharmacopoeia of India (API) include some official markers, but only a small fraction are water soluble or relevant in finished products. To address this, studies on bioactive markers that are pharmacologically relevant is crucial.

HERB/FORMULATION	MARKER COMPOUND	EXTRACTION	ANALYTICAL TECHNIQUE	TESTING CHALLENGS
TURMERIC	CURCUMIN	SOLVENT EXTRACTION (ETHANOL, ACETONE)[17]	HPLC, UV-Vis SPECTROSCOPY, LC-MS	Stability issues during processing, storage, degradation under light, Heavy metal contamination.
BRAHMI	BACOSIDES	METHANOL/ WATER EXTRACTION, REFLUX OR ULTRASONIC METHODS	HPTLC, HPLC, LC-MS	Low conc. Of saponins, co-elution of other triterpenoids
GUGGULU	GUGGULUSTERONE	ORGANIC SOLVENT EXTRACTION	HPLC, LC-MS	Low abundance in resin, degradation in light and heat

GOVERNMENT INTERVENTIONS TO IMPROVE INTERNATIONAL ACCEPTANCE

Ayush Ahara Project is a joint venture between the Ministry of Ayush and the Food Safety and Standards Authority of India (FSSAI).[18] Its purpose is to oversee and promoter for Ayurvedic nutritional products. This partnership focuses on guaranteeing the production of high standard Ayurvedic food items while facilitating the growth of these products in global markets. This program has resulted in the development of several Ayurvedic food items and are manufactured by FSSAI certified producers to ensure safety and excellence. The Rashtriya Ayurveda Vidyapeeth (RAV) has partnered with organizations like Jamia Hamdard University and the National Institute of Food Technology Entrepreneurship and Management (NIFTEM). Together, they provide training to Ayurveda graduates on how to prepare Ayurvedic food products, encouraging new business ventures within the industry. The All India Institute of Ayurveda (AIIA) manages research initiatives regarding food innovations based on Ayurveda. They investigate and confirm dietary theories aimed at achieving long term nutritional benifits.

It is mandatory for Ayush Aahar goods to follow the guidelines set by the Food Safety and Standards Act of 2006, along with related statutes. The Ministry of Ayush has presented

Ayush Aahar items at global gatherings like World Food India. These presentations emphasize the product's ability to manage lifestyle related conditions.

Public organizations such as CSIR (Council of scientific and industrial research) CFTRI (Central Food Technological research Institute) and ICAR (Indian Council of Agricultural Research) CMFRI (Central Marine Fisheries Research Institute) have pioneered the commercialization of functional products, such as seaweed based extracts for diabetes and obesity management. Additionally, NIFTEM receive funding from agencies like DST (Department of Science and Technology) and MoFPI (Ministry of Food Processing Industries) to advance research in non thermal processing and raw material utilization. Kerala government introduced the nation's first Nutraceutical Centre of Excellence in 2024 to facilitate Al driven research and clinical testing. The NRDC (National Research Development Corporation) supports startups by providing mentorship, seed capital, and technology licensing to bring scientifically validated products to market. Higher education institutions are designing specialized curricula, such as the postgraduate courses in nutraceutical sciences offered by the Nutrify Today Academy in partnership with Centurion University. These programs utilize Al tools like NutrifyGenie to bridge the gap between classroom learning and practical research and development.

AYURVEDIC PHYTOPHARMACEUTICALS

India has introduced a modern regulatory framework defined as phytopharmaceuticals, a new class of drugs designed to bridge traditional herbal knowledge with the rigors of modern pharmaceutical science. Phytopharmaceuticals are defined in the Indian regulatory context by the Central Drugs Standard Control Organization (CDSCO) as purified and standardized fractions of medicinal plant extracts that contain a minimum of four bioactive or phytochemical markers (with at least one being bioactive).[19] These markers are quantified using advanced analytical techniques such as HPLC (High Performance Liquid Chromatography), LC MS (Liquid Chromatography Mass Spectrometry), GC MS, and spectroscopic fingerprinting. These drugs are intended for internal or external therapeutic use and must undergo clinical testing, similar to synthetic drugs. Standardization of phytochemical markers in these products ensures batch to batch consistency, reliable therapeutic efficacy, and patient safety. For example, inclusion of a phytopharmaceutical ingredient (PPI) monograph in the Indian Pharmacopoeia now provides formal benchmarks

for identifying and quantifying these markers in extracts, ensuring high quality and reproducibility and thereby strengthening scientific credibility.

This robust scientific framework makes phytopharmaceuticals highly valuable for the development of nutraceuticals. Phytopharmaceutical research provides validated data on bioactive compounds, mechanisms of action, bioavailability, and dose optimization, which can directly inform nutraceutical formulation. For example, once a plant extract is characterized and standardized as a phytopharmaceutical, lower dose or preventive formulations can be developed as nutraceuticals targeting immunity, metabolic health, cognitive support, and inflammation. The availability of safety and efficacy data reduces regulatory issues and increases consumer trust. Moreover, techniques such as bioenhancement, nano delivery systems, and encapsulation, commonly used in phytopharmaceutical development, can significantly improve the bioavailability of nutraceutical ingredients.

Several existing phytopharmaceutical products demonstrate this translational potential. Sinecatechins, a standardized green tea (Camellia sinensis) extract, is approved globally as a botanical drug for treating genital warts.[29] The same catechin-rich extracts are widely used in nutraceuticals for antioxidant and cardiometabolic health, supported by phytopharmaceutical research. Another example is Crofelemer, derived from Croton lechleri, approved as a botanical drug for HIV associated diarrhea.[21] Its validated mechanism regulation of chloride ion channels has encouraged exploration of related extracts for gut health nutraceuticals. In the Indian context, research on plants such as Withania somnifera (Ashwagandha), Curcuma longa (Turmeric), and Commiphora mukul (Guggulu) under phytopharmaceutical principles has strengthened their global acceptance as nutraceutical ingredients.

In conclusion, phytopharmaceuticals serve as a scientific bridge between Ayurveda and modern nutraceutical development. By providing validated bioactive profiles, safety data, and mechanistic understanding, they enable the creation of high-quality, effective, and globally acceptable nutraceuticals while preserving the essence of traditional plant-based medicine.

DISCUSSION

The growing prevalence of lifestyle disorders has increased the demand for preventive healthcare, making Ayurvedic nutraceuticals an attractive option due to their holistic

approach toward improving digestion, immunity, metabolism and overall well being by combining Ayurvedic principles with modern scientific approaches to produce safe, effective and consumer friendly products. Scientific authentication of raw materials using techniques such as DNA barcoding, HPTLC, HPLC, LCMS etc along with adherence to traditional Ayurvedic selection criteria, improves product quality and ensures consistency. Modern dosage forms, advanced extraction methods and novel drug delivery systems such as nanoformulations, phytosomes and bioenhancers further enhance stability, bioavailability and patient compliance.

However, global acceptance remains limited by challenges including adulteration, variability in phytochemical composition, heavy metal contamination and stringent international regulatory requirements. These issues highlight the importance of standardization, quality assurance, validated marker compounds and Good Manufacturing Practices. Therefore implementation of Good Agriculture and Collection Practices (GACP), GMP, GCP, GLP are essential for international acceptance. Government initiatives and research programs like Ayush Aahar, FSSAI regulations, CFTRI, NIFTEM and other institutional collaboration are actively supporting innovation, standardization and commercialization of Ayurvedic nutraceuticals.

The emergence of phytopharmaceuticals has further strengthened the scientific credibility of Ayurvedic products by introducing standardized extracts, validated bioactive markers and clinical evidence. This integration of traditional knowledge with modern pharmaceutical science provides a promising pathway for developing globally accepted Ayurvedic nutraceuticals.

CONCLUSION

Ayurvedic nutraceuticals have significant potential in preventive healthcare by integrating traditional Ayurvedic principles with modern scientific approaches. Advances in standardization, quality control, novel formulation technologies, and phytopharmaceutical research are improving their safety, efficacy, and global acceptance. Continued research, regulatory harmonization, and scientific validation will further strengthen their role in the international nutraceutical market.

REFERENCES

1. World Health Organization. Management of noncommunicable diseases [Internet]. Geneva: WHO; Available from: WHO Management of Noncommunicable Diseases.
2. Aronson JK. Defining ‘nutraceuticals’: neither nutritious nor pharmaceutical. Br J Clin Pharmacol, 2017.
3. Available from Defining 'nutraceuticals': neither nutritious nor pharmaceutical - PubMed
4. Agnivesha. Charaka Samhita with Ayurveda Dipika Commentary of Chakrapanidatta. Edited by Vaidya Jadavji Trikamji. New Delhi: Chaukhambha Orientalia; Reprint, 2011.
5. Vaidya ADB, Devasagayam TPA. Phytopharmaceuticals: A new drug class regulated in India. Perspect Clin Res, 2016.
6. Available from Phytopharmaceuticals: A new drug class regulated in India - PMC.
7. Kokate CK, Purohit AP, Gokhale SB. Pharmacognosy. 57th ed. Pune: Nirali Prakashan, 2023.
8. Indrayanto G. Advances in fingerprint analysis for standardization and quality control of herbal medicines. Front Pharmacol, 2022.
9. Available from Advances in Fingerprint Analysis for Standardization and Quality Control of Herbal Medicines - PMC.
10. Sharma PV. Dravyaguna Vijnana. Vol. I. Varanasi: Chaukhambha Bharati Academy; Latest edition.
11. Raj RM, Kumar A, Srivastava A, et al. The Journey of Extraction: Review from Ancient Practices to Modern Technologies. Asian J Res Chem, 2025.
12. Available from [PDF] The Journey of Extraction: Review from Ancient Practices to Modern Technologies | CiteDrive
13. Vagbhata. Ashtanga Sangraha with Shashilekha Sanskrit Commentary by Indu. Vol. 1. Edited by Shivprasad Sharma. 3rd ed. Varanasi: Chaukhambha Sanskrit Series Office, 2012.
14. Sharma R, Gupta N, Sharma VB, Singh U. Nutraceuticals in Ayurveda with special reference to Yavagu: A review article. Int Res J Ayurveda Yoga, 2020.
15. Available from Nutraceuticals in Ayurveda w.s.r to Yavagu: A Review Article | International Research Journal of Ayurveda and Yoga.
16. Atal CK, Dubey RK, Singh J. Biochemical basis of enhanced drug bioavailability by piperine: Evidence that piperine is a potent bioenhancer. J Pharmacol.
17. Available from Biochemical basis of enhanced drug bioavailability by piperine: evidence that piperine is a potent inhibitor of drug metabolism - PubMed.

18. Anand P, Kunnumakkara AB, Newman RA, Aggarwal BB. Bioavailability of curcumin: Problems and promises. Mol Pharm, 2007.
19. Available from Bioavailability of curcumin: problems and promises - PubMed.
20. Chandrasekhar K, Kapoor J, Anishetty S. A prospective, randomized double-blind, placebo-controlled study of safety and efficacy of a high-concentration full-spectrum Ashwagandha root extract in reducing stress and anxiety in adults.
21. Available from A Prospective, Randomized Double-Blind, Placebo-Controlled Study of Safety and Efficacy of a High-Concentration Full-Spectrum Extract of Ashwagandha Root in Reducing Stress and Anxiety in Adults - PMC.
22. Chhonker YS, Chandasana H, Kumar D, Kumar V, Kumar N. Assessment of in vitro metabolic stability, plasma protein binding, and pharmacokinetics of E- and Z-guggulsterone in rat.
23. Available from Assessment of in vitro metabolic stability, plasma protein binding, and pharmacokinetics of E- and Z-guggulsterone in rat - PubMed.
24. Chen X, Zhang Y, Wang Y, et al. 15 Comparison of regulations for arsenic and heavy metals in herbal medicines using pharmacopoeias of nine countries/regions. Chinese Herb Med, 2023.
25. Available from Comparison of Regulations for Arsenic and Heavy Metals in Herbal Medicines Using Pharmacopoeias of Nine Counties/Regions - PMC.
26. Mishra P, Kumar A, Nagireddy A, Mani DN, Shukla AK, Tiwari R, et al. DNA barcoding: An efficient tool to overcome authentication challenges in the herbal market. Plant Biotechnol J., 2016.
27. Available from DNA barcoding: an efficient tool to overcome authentication challenges in the herbal market - PubMed.
28. Priyadarsini KI. Curcumin: Biological, pharmaceutical, nutraceutical, and analytical aspects. Molecules, 2019.
29. Available from Curcumin: Biological, Pharmaceutical, Nutraceutical, and Analytical Aspects - PMC.
30. Food Safety and Standards Authority of India. Food Safety and Standards (Ayurveda Aahara) Regulations, 2022. New Delhi: FSSAI, 2022.
31. Government of India. Ministry of Health and Family Welfare. G.S.R. 918(E): Drugs and Cosmetics (Amendment) Rules, 2015. New Delhi: Gazette of India; 30 Nov 2015.

32. Tatti S, Swinehart JM, Thielert C, Tawfik H, Mescheder A, Beutner KR. Sinecatechins (Polyphenon E) ointment for treatment of external anogenital warts: a randomized controlled trial. Obstet Gynecol, 2008.
33. Frampton JE. Crofelemer: a review of its use in the management of non-infectious diarrhoea in adult patients with HIV/AIDS on antiretroviral therapy. Drugs, 2013.
34. Avaialble from Crofelemer: a review of its use in the management of non-infectious diarrhoea in adult patients with HIV/AIDS on antiretroviral therapy - PubMed.