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EXPLORING THE TIMELESS WISDOM OF AYURVEDIC MEDICINE: A COMPREHENSIVE REVIEW

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ABSTRACT

An extensive summary of the application of Ayurvedic medicine to modern health and wellness issues is given in this review article. It emphasizes how modern lifestyles have led to a revived interest in wellness and how ancient dietary practices have given way to more modern ones, with a focus on preventive care rather than expensive sick treatment. In order to promote Ayurveda globally, the paper emphasizes the necessity for more study and evidence-based validation. The ancient holistic medical system known as Ayurveda is investigated as a potentially useful treatment for chronic conditions like diabetes, cancer, rheumatoid arthritis, and asthma that are frequently deemed incurable by contemporary medicine. Unfortunately, acceptance of many Ayurvedic notions has been hampered by their lack of scientific support. In order to increase Ayurveda's acceptance throughout the world, the study highlights the significance of evidence-based research and the creation of cutting-edge research methodology. The merging of contemporary scientific evidence-based medicine with traditional knowledge systems like Ayurveda is also covered in the essay. It emphasizes how important it is for Ayurvedic researchers to work with creative projects and adjust to new developments in the field of medicine. The article also explores the many forms and uses of iron in Ayurvedic medicine,

with a focus on how it can be used to treat ailments like fever, anaemia, piles, and inflammatory illnesses. The potential clinical utility of adaptogenic herbs and the fusion of Ayurveda with evidence-based medicine are discussed. The essay also discusses the dangers of hazardous metals present in some Ayurvedic medications, emphasizing the necessity of industrial safety protocols and quality assurance. It also covers some Ayurvedic plant extracts' antioxidant qualities, which have demonstrated promise in reducing oxidative stress. In order to assure the safety and effectiveness of Ayurvedic medicines, the review finishes by highlighting the significance of standardized operational methods for herbal pharmaceuticals and formulations, with a particular focus on quality control and quality assurance. This strategy is thought to be essential for building confidence and interest in traditional plant-based remedies across borders, which could increase poor nations' income from the global herbal market.

KEYWORDS: Ayurvedic Medicine, Contemporary challenges, Evidence-Based Research, Integrative medicine, Adaptogenic plants, Antioxidant properties, Global Recognition.

INTRODUCTION

Ayurveda, an ancient Indian pharmaceutical tradition that dates back to 2500-500 BC, is referred to as the "Science of Life" and the "Science of Longevity." It provides holistic solutions to a variety of health conditions, encourages self-empowerment, personalised nutrition, and rejuvenation, and is gaining popularity in our modern, fast-paced existence.[1] Ayurveda promotes holistic health and personalised healing. With over 80% of Indian patients seeking Ayurvedic therapy due to worries about the limitations and side effects of contemporary medicine, combining Ayurveda with allopathic medicine shows potential. However, comprehending allopathic physicians' perspectives, particularly postgraduate residents, is lacking. This research seeks to fill that gap by analysing their knowledge, attitudes, and practises about Ayurvedic therapies and integrative medicine.[2,4] The significance of iron, which is based in Greek and Roman mythology, heralded the beginning of the Iron Age, which represented human development. Its functions in plant chlorophyll, haemoglobin, and cellular processes have been traced back to ancient traditions such as Ayurveda. This study delves into the several applications of iron listed in the renowned medical compendium, Bhaisajya Ratnabali.[5] Lead, mercury, and arsenic have been detected in a substantial proportion of Indian-manufactured traditional Ayurvedic medicines. Metals may be present due to the practice of rasa shastra (combining herbs with metals, minerals,

and gems). Whether toxic metals are present in both US- and Indian-manufactured Ayurvedic medicines is unknown.[6] Ayurvedic and Siddha medicine both rely on plant-based diets in India. Recent research emphasises the importance of antioxidants in disease prevention. The antioxidant capacity of four Ayurvedic herbs is investigated in this study, with a focus on their role as natural antioxidants. Momardica charantia Linn, Glycyrrhiza glabra, Acacia catechu, and Terminalia chebula are among the plant's endemic to India and Asia.[7] Ayurveda, or the "Science of Life," is one of the world's oldest medicinal systems, dating back over 5,000 years. Its fundamental goal, rooted in the Indian subcontinent, is to promote wellbeing and harmony between humans and nature. Ayurveda contains a wide range of information and diagnostic techniques, as well as a variety of pharmaceutical formulations, with fermented preparations such as arishtas and asavas gaining popularity for their therapeutic efficacy and distinctive properties.[8] Clitoria ternatea, often known as butterfly pea or shankapushpi, is an important Ayurvedic and traditional Indian medicine plant. It is recognised as a brain tonic with memory-enhancing effects, which aligns with Ayurveda's holistic approach. This review looks at its traditional usage, pharmacognosy and pharmacological effects, as well as its therapeutic potential.[9] Cancer's global influence necessitates low-cost, low-risk treatments. Ayurveda, an ancient Indian medical practise that emphasises the therapeutic power of food, fits with modern discoveries that many medications, including those used to treat cancer, are derived from plants. This review examines the potential of Ayurvedic and dietary medicines in cancer prevention and therapy, focusing on their anti-inflammatory and chemo preventive qualities.[10] Medicine developed independently throughout Egypt, China, India, Greece, and Persia, laying the groundwork for contemporary pharmaceuticals. Despite advances in synthetic medicine, plant-based medicines remain critical, particularly in developing countries. Pharmaceutical corporations are rediscovering plant-based treatments due to its low cost and historical efficacy.[11]

TEXT/DISCUSSION

Medicinal Plants Used in Alternative/Traditional Medicines

Alternative medicines are playing an important part in global healthcare, with around 60% of the global population using them. These practises are common not only in underdeveloped countries, but also in rich countries where modern medicine reigns supreme. India, in particular, has a rich storehouse of medicinal plants utilised in traditional medical treatments, derived from herbs, minerals, and organic matter. Traditional Ayurvedic medicine is used by

over 70% of India's rural population, and more than 1.5 million practitioners use traditional systems of medicine for healthcare. With over 20,000 recognised species, India is the largest producer of medicinal herbs, yet traditional practitioners generally employ 7,000-7,500 plants. This growing interest in traditional medicine is fueled by concerns about the side effects, adverse reactions, and cost of modern medicines.

Approximately 40% of the population in Western countries uses herbal medication for various conditions. In reaction to the problems connected with modern medications, governmental authorities and non-governmental organisations (NGOs) are expanding their attention and support for this trend. Over 7,800 manufacturing facilities in India are believed to be involved in the production of natural health products and traditional plant-based formulations, requiring more than 2,000 tonnes of medicinal plant raw material annually. Overall, alternative medicines are filling a critical healthcare vacuum for people who do not use or cannot obtain comfort from traditional medical systems.[1]

Expanding Complementary and Alternative (CAM) Approaches

Over 80% of the population in underdeveloped countries cannot afford basic medical procedures, medications, or vaccines, underlining severe healthcare access difficulties. Complementary and alternative medicine practises are becoming more popular among wealthy people in both developed and developing countries, despite minimal proof of their safety and effectiveness. Evidence-based research in Ayurveda is gaining popularity in India and around the world, and the United States has formed the National Centre for Complementary and Alternative Medicine to investigate these healing practises systematically, support research, and communicate information to the public. People's choices of complementary and alternative medicine are influenced by economic factors, with the assumption that they are less expensive than traditional therapies. However, studies have shown that cost is not always the most important consideration, as people may select these approaches for a variety of reasons, including confidence in the treatment, convenience of access, and lesser expected adverse effects. Traditional medicine is not only used by the poor; users of alternative treatments frequently seek conventional healthcare as well. This demonstrates the intricate interplay of economic, social, and cultural elements in affecting healthcare decisions in both developed and developing countries.[1]

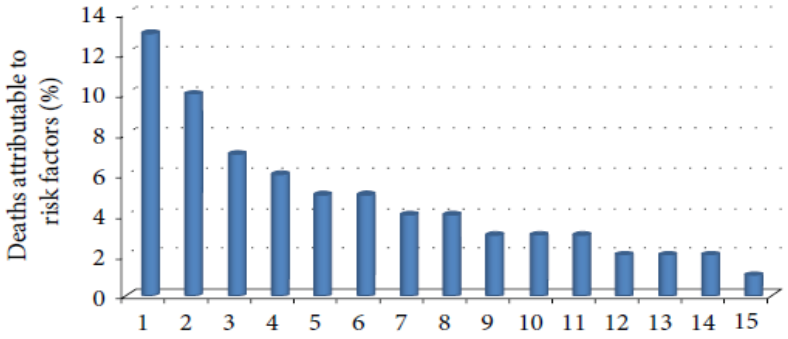

FIGURE 1: Risk factors related to nutrition— 1: underweight, 2: unsafe sex, 3: blood pressure, 4: unsafe water, sanitation and hygiene, 5: cholesterol, 6: tobacco, 7: indoor smoke from solid fuels, 8: low fruit and vegetable intake, 9: zinc deficiency, 10: iron deficiency, 11: vitamin A deficiency, 12: physical inactivity, 13: alcohol, 14: overweight, and 15: unsafe healthcare injections.

Why Ayurveda is lagging behind?

Ayurvedic treatment is frequently seen to be more beneficial than allopathic medicine for chronic conditions. However, it is less common due to the desire for modern medicine, which delivers faster relief. Concerns about allopathic medicine toxicity and rising healthcare expenses have prompted more people to look into alternatives. It is critical not to compromise Ayurveda's essential principles in order to improve its core competency. The lack of clarity among new scholars regarding the future of Ayurveda and how to stimulate research is one of the challenges to its advancement. Few organisations have specialised research infrastructure, thus skilled researchers with understanding of new technology are required. Scepticism among biomedical scientists impedes collaboration. While many Ayurvedic postgraduates graduate each year, just a handful go on to work in research. Ayurvedic education and textbooks have not advanced in the last 50 years, necessitating the use of modern research approaches. Addressing these difficulties is critical to the advancement of Ayurvedic research.[2]

Improvement In Research Methodology and Development of Ayurvedic Pharma Sector and Literature

Ayurvedic research methodology entails systematic data collecting, analysis, and interpretation in order to satisfy the demand for fundamental research in India. While Ayurveda is a recognised traditional system, there is an urgent need to refresh and improve knowledge that was lost during British control. Ayurvedic historical research approach depends on tools like as direct observation, inference, and authoritative testimonials. Modern

research methods expand on these ideas and enhance them with technical breakthroughs, contributing to the modern medical community's grasp of Ayurveda. The classical approach, basic principles (Prakriti, Agni, etc.), and interdisciplinary collaboration must all be considered while defining Ayurveda and research technique. Ayurvedic research requires a comprehensive approach, personalised therapy, and extensive understanding of diagnostics, materials, and dosage form. Ayurvedic research includes literary, basic, pharmacological, pharmaceutical, and clinical research, each of which necessitates distinct methodologies and skills. The ultimate goal is to revitalise and advance Ayurveda's essential principles, which will benefit not only India but the entire world. It is critical to incorporate basic sciences such as physics, chemistry, molecular biology, biotechnology, ethnopharmacology, ayurvedic drug discovery, pharmacoepidemiology, and reverse pharmacology into Ayurveda study. This interdisciplinary approach is critical in Ayurvedic research, particularly in the context of integrative medicine, for a comprehensive knowledge and favourable outcomes. Western countries have embraced a multidimensional approach to medicine by integrating traditional and contemporary medicine, recognising the clinical usefulness of many traditional medicines in comparison to modern medicine. As a safe and effective traditional system, Ayurveda has the ability to lessen the burdensome side effects of contemporary pharmaceuticals and battle infections, especially those caused by antibiotic-resistant microorganisms. As a result, interdisciplinary research is critical in tackling chronic diseases and developing Ayurveda's potential. Ayurvedic medicine development is strongly reliant on the collaboration of medication production and supporting sectors. This vast system includes raw material collectors, dealers, the processing and manufacturing sectors, Ayurvedic practitioners, and customers, all of whom must be encouraged and supported. With approximately 1100 medicinal plants in use, at least 60 of which are in high demand, providing a continuous and inexpensive supply of raw materials is a big concern. To address this issue, the government and industry partners must implement severe procedures in order to meet market expectations. This entails thorough monitoring of the whole raw material cycle, from harvesting to processing, transportation, and storage, as well as the use of contemporary DNA fingerprinting and chemo profiling techniques to choose the appropriate germplasm, ensuring the accuracy and quality of Ayurvedic medicines. Due to the limits and obstacles imposed by regulatory bodies and the scientific community, Ayurveda confronts challenges in attaining global acceptability. There is a shortage of evidence-based research in the available literature on Ayurvedic treatment, prompting the need for more scientifically rigorous investigations to establish its effectiveness. The Digital Helpline for Ayurveda

Research publications, which currently provides access to Ayurvedic research publications, should be enhanced and updated. While thousands of articles are indexed in PubMed each year, only a small part of them are dedicated to Ayurveda research, as opposed to Traditional Chinese Medicine (TCM), which accounts for around 12% of total published papers. To obtain international recognition, Ayurvedic literature must boost its contribution to PubMed.[2]

Combination of Ayurveda and Western

Medicine and Improvement in Personalised Medicine with Modern Technology

Ayurveda has received considerable attention in academic circles, owing mostly to its efficiency in treating chronic disorders, where modern drugs frequently fall short. Western medicine, on the other hand, was introduced to Asian countries in the early 16th century and soon acquired appeal due to its quick-acting nature, eventually overshadowing traditional medicinal systems. Surprisingly, Ayurveda and Western medicine can complement one other in some cases. In the instance of rheumatoid arthritis, for example, which is frequently untreatable with current Western medicine, methotrexate generates only a partial response in a small number of patients while offering potential side effects. As a result, a significant number of arthritis patients seek out complementary and alternative medicines, such as Ayurveda. This emphasises the possibility for Ayurveda and Western medicine to collaborate for the good of humanity.

Ayurveda and Western medicine should be viewed as complimentary techniques, each with strengths that can be combined to improve healthcare outcomes. This collaboration could lead to more effective treatment choices for a variety of disorders, as well as a more holistic approach to medical care that incorporates the best of both traditional and modern medical systems. The holistic approach to treatment used by Ayurveda, which attempts to heal the individual as a whole, contrasts with the Western system of medicine's conventional concentration on a curative model. It is now critical to create a new medical system paradigm that incorporates both healing and curative approaches. The introduction of personalised medicine has the potential to significantly improve healthcare by allowing for the prediction of illness risks, the prevention of disease development, and more efficient treatment management. Pharmacogenetics and pharmacogenomics advances are critical to achieving personalised medicine goals. It is not only about finding the right drug for the right person, but also about identifying the right drug for a specific disease affecting a specific person,

ultimately making clinical trials more efficient, lowering costs associated with side effects, and optimising drug prescriptions based on genotype.

Personalised medicine has historical roots and has evolved with a modern focus on DNA, including the impact of single nucleotide polymorphisms and epigenetic variables on drug reactions. To progress personalised medicine by the use of modern scientific tools, it is critical to ensure that treatment may be tailored to the individual patient's specific needs and genetic composition.[2]

Ayurveda, an ancient and holistic Indian medical system, places a heavy emphasis on personalised wellness. It regards life as the union of the body, senses, mind, and spirit, and its therapies emphasise the concept of Prakriti, or individual nature. Ayurveda is distinguished by its holistic approach to healthcare, which encompasses health promotion, disease prevention, early detection, and personalised treatment. There are numerous parallels between Ayurveda and the revolutionary method of predictive, preventative, and personalised medicine (PPPM), demonstrating Ayurvedic ideas' continuous relevance. Ayurveda has long been seen as requiring scientific study because the practise entails a constitutional assessment that can guide prevention, diagnosis, and therapies. Ayurveda gives thorough dietary, nutrition, and diet advice that is customised to an individual's constitution and the changing seasons. In the framework of biology and genetics, modern research is looking into the scientific validity of Ayurvedic principles like Prakriti. While the essential principles of Ayurveda remain relevant, the changing presentations of diseases, environmental conditions, human genetics, and lifestyles necessitate ongoing research, development, and adaptation to assure the efficacy and safety of Ayurveda. For systematic advancement, the Ayurvedic community must be open to new ideas, concepts, and knowledge. Collaboration with Western researchers and institutions that practise Ayurveda is critical in terms of traditions and professional ability. Ayurvedic practise should evolve with new techniques and technologies while maintaining its epistemic worth. In Ayurveda, embrace of modernity does not imply uncritical acceptance of Western reasoning, but rather integration with Western biomedicine and current science. Ayurvedic scientific study should try to assess health outcomes while minimising bias, chance effects, and confounders. To create the evidence base for Ayurvedic medicines and therapeutic practises, rigorous scientific research is required, utilising methodologies relevant to its unique character and holistic approach. Efforts in this direction

will help establish Ayurveda as an evidence-based medicine and bridge the gap between traditional and modern healthcare practices.[3]

Evidence Base for Ayurveda and Evidence Based Medicine

The advent of evidence-based medicine (EBM) has drastically altered the landscape of healthcare research and practise. Archie Cochrane's pioneering work and the invention of meta-analysis as a research methodology paved the door for systematic reviews, a powerful tool that aided physicians and researchers in decision-making processes. These efforts eventually resulted in the evolution of EBM, emphasising the necessity of consistent clinical practise quality and scientific evidence quality. EBM has emerged as a critical technique for ensuring that medical decisions are based on rational and analytical evidence gathered through rigorous research-backed practises. It is critical to consider evidence from two key sources when evaluating Ayurveda as an evidence-based medicine. To begin, historical, classical, and current therapeutic practises serve as a foundation for proof, needing rigorous documentation to back up diverse claims. Simply citing historical sources is insufficient; comprehensive verification of current clinical practises is required. Second, scientific research is important in bolstering Ayurvedic theories, treatments, and processes. A critical analysis is required to assess the current state of clinical practise and scientific research in Ayurvedic medicine. This examination should include both traditional practises and modern scientific research methodologies, providing for a thorough knowledge of Ayurveda's evidence-based foundation. To summarise, establishing Ayurveda as an evidence-based medicine requires the synthesis of historical knowledge, present clinical practise, and rigorous scientific research. Ayurveda may continue to progress and contribute significantly to evidence-based practises by critically analysing both historical and scientific aspects, ensuring the appropriate integration of ancient wisdom with modern research approaches.[3]

Scientific Evidence

In terms of scientific evidence, Ayurveda now falls far short of modern standards, notably in the context of randomised controlled clinical trials (RCTs) and systematic reviews, which are considered the highest level of evidence. Ayurveda lags behind in terms of both the quantity and quality of RCTs and systematic reviews, as evidenced by its lack of representation in databases such as the Cochrane Library, with only one systematic review, whereas disciplines such as homoeopathy and Traditional Chinese Medicine (TCM) have significantly more. Despite extensive financing and big national efforts, clinical studies on Ayurvedic remedies

frequently fail to reach the desired rigour. This raises concerns about the RCT model's viability for Ayurvedic research, as RCTs have been criticised for their application in specific contexts. Nonetheless, the unsuitability of RCTs should not be used as an excuse to forego serious scientific study and clinical documentation in Ayurveda. National programmes on Ayurvedic biology, Ayugenomics, whole systems clinical research, good clinical practise guidelines, digital helplines, decision support systems, and systematic reporting requirements have all been implemented to improve Ayurvedic research and practise. While certain noteworthy initiatives aiming at comparing the efficacy of sophisticated Ayurvedic and Western treatments have produced empirical evidence, their impact on the scientific community has yet to be completely realised. Improving collaboration between the Ayurvedic and modern scientific communities has been seen as a critical step forward. However, in research journals, Ayurvedic medicine is still deemed subcritical, and the overall scientific data supporting Ayurveda is insufficient. This situation has resulted in limits imposed on Ayurvedic medications by governing bodies such as the House of Lords and the European Union, as well as worries regarding the quality and safety of Ayurvedic goods, such as the presence of heavy metals and other compromising chemicals. Addressing these issues is critical for the creation of a solid evidentiary base for ayurveda and its wider acceptability.[3]

TABLE 1: Impact of modern food concept in required nutrition.

Nutrients	Intake by traditional ways	Intake by modern ways	Effect on nutrient intake
Water soluble vitamins (vitamins B and C) and minerals	Vegetables used for cooking were/are fresh	Freezing and packaging of the cut vegetables	Loss of ascorbic acid, water soluble vitamins, and minerals
Proteins, minerals, and vitamin B complex	Manual processing of cereals, without polishing	Milling and polishing of cereals	Reduces protein, minerals, and vitamin B complex
Calcium, iron, thiamine, and niacin	Fresh grinding at home	Heavy milling and poor storage conditions	Loss of calcium, iron, thiamin, and niacin
Iron	Cooking in iron pot	Food generally cooked in cookware like nonstick and Teflon-coated utensils	The benefit of organic iron from the conventional iron pot is not obtained by using modern cookware
Copper	Storing of water and cooking use of copper vessels	Stainless steel utensils and plastic wares	Copper required in minor amount which is not gained from modern utensils used today. Deficiency is known to cause chronic diarrhea, malabsorption problems, and reduce immunity. Use of plastic containers is also harmful

In a poll of 112 inhabitants, 89% consented to fill out a questionnaire, providing significant insights into their opinions and knowledge about Ayurveda. The bulk of residents were men, accounting for 73% of those polled. The residents' average age was 26.47 years, with a

standard deviation of 1.65 years. Surprisingly, 48% of the polled locals were aware with Doshas, a core concept in Ayurveda, while 52% were not. When asked about Panchakarma, 81% of residents had no idea what this Ayurvedic therapy was. A sizable proportion (49%) stated that a sizable proportion of the public, ranging from 20-40%, consistently uses Ayurvedic medicine in their routine healthcare. A startling 99% of the people, however, said that they had no opportunity to learn about Ayurveda. Furthermore, the residents have conflicting feelings about incorporating Ayurveda into modern medical practise. While 46% were willing to recommend patients to Ayurvedic practitioners, 35% were opposed. A large majority (92%) believed that Ayurvedic medicines should be subjected to further scientific research before being widely used. Approximately 60% of the residents thought that introducing Ayurvedic remedies into medical practise would improve patient satisfaction and attract more patients. There was also agreement that physician knowledge of Ayurvedic practises could result in improved patient outcomes. However, there was no agreement on the idea of post-graduate Ayurvedic volunteer courses. Most residents opposed mandatory post-graduate training in Ayurvedic medicine, whereas opinions on the merging of Ayurveda and contemporary medicine were mixed, with 68% in favour and 32% opposed. A majority (93%) disapproved with referring patients to Ayurvedic outpatient departments, although 94% agreed that individuals frequently seek Ayurvedic remedies before contacting allopathic doctors. Furthermore, 71% of locals did not believe it was necessary to consult an Ayurvedic physician, whereas 29% were receptive to the concept. Finally, 69% of allopathic doctors had prescribed branded Ayurvedic products, showing a level of acceptance and integration of Ayurveda into modern medical practise, whereas 31% had not.

Table 2: Response of allopathic doctors towards attitude questions.

Questions for finding attitude of allopathy residents toward Ayurvedic drug use	Affirmative % (agree/ strongly agree)	Negative % (disagree/ strongly disagree)
You would refer a patient to an Ayurveda practitioner if available at a tertiary care hospital for treatment of an ailment	55	45
Ayurvedic medicines need more scientific testing before being used	92	8
Incorporation of Ayurveda therapies into the practice would result in increased patient satisfaction and attract more patient	78	22
Physician's knowledge of Ayurveda practices leads to better patient outcome	75	25
Doctors should have knowledge about the most common Ayurveda therapies	86	14
Ayurveda and modern medicine should be integrated	68	32

The study looked at allopathic resident doctors' Knowledge, Attitudes, and Practises (KAP) regarding the use of Ayurvedic treatment. The data show that locals have a substantial lack of knowledge about Ayurvedic ideas, with only 48% aware of Doshas and an astounding 81% unaware of Panchkarma. These doctors' primary sources of information were their colleagues and promotional literature, demonstrating the powerful influence of peer pressure and industry-driven content. Residents were aware with the names of many Ayurvedic remedies, with LIV 52 being widely utilised, often in situations of liver diseases, despite their inadequate comprehension. This shows that there is a growing interest in Ayurvedic treatments, particularly for ailments for which contemporary medicine has few options, such as liver disorders, arthritis, skin conditions, and diabetes. While many residents felt that a significant section of the community (20-40%) used Ayurvedic medicine, there were few opportunities to study about Ayurveda in their medical education. Referring patients to Ayurvedic practitioners divided opinion, with 46% in favour of this method, but a large 93% having never referred patients to Ayurvedic outpatient departments. While many residents were apprehensive to interact with Ayurvedic physicians, they recognised the predominance of patients seeking Ayurvedic care before consulting with allopathic specialists. Notably, the survey found that the majority of residents (68%) favoured the merger of Ayurveda and contemporary medicine, and that increased physician knowledge of Ayurveda could improve patient satisfaction and attract more patients. However, there was no agreement on whether Ayurvedic training should be mandatory or voluntary in medical school, with the majority of residents opposing such proposals. Due to the scarcity of randomised controlled trials, several people expressed a need for further scientific testing of Ayurvedic remedies. Despite a lack of complete knowledge and training, a significant 69% of allopathic residents had prescribed branded Ayurvedic remedies, raising concerns regarding patient safety. While 76% of respondents agreed with the existing legal limits on allopathic doctors practising Ayurveda, 24% were receptive to the concept of permitting cross-practice. These findings highlight the complex and changing connection between allopathic medicine and Ayurveda, which is influenced by medical professionals' various levels of understanding and acceptance.[4]

Table 3: Common reasons given by allopathicdoctors for not allowing cross practice.

Reasons given by allopathic doctors for not allowing cross practice	Response in %
No response	34
Lack of knowledge about drug interactions, side effects and proper training	36
Ayurvedic drugs do not undergo scientific testing	2
There are better options than Ayurveda	1
Cannot be used in emergency	1
Cross practice not allowed by law	1
This can lead to malpractice	1

Iron has been employed in Indian medicine since the Vedic time. Blood is characterised in Ayurveda as "Lauha Gandhi," which translates to having an iron-like odour, suggesting an early knowledge of the role of iron in the organism. For millennia, minerals have been an important component of Ayurvedic remedies, and iron is no exception. Iron was processed in cow's urine and utilised therapeutically in ancient times, primarily as Ayaskruti or Lauha rasayana. Ayaskruti entailed heating thin iron plates to a red-hot temperature before immersing them in Amalaki juice. This practise can be traced back to classical Ayurvedic writings such as the Charaka Samhita. Rasashastra development, driven by intellectuals such as Nagarjuna, perfected iron processing over time, eventually giving rise to iron bhasma, a medicine delivery mechanism. Nagarjuna's contributions are noteworthy, and he is regarded as a forerunner in the field of metals medicine in India. Rasa-Sastra (Alchemy), a particular field of medicine focusing on herbo-mineral products, arose as a result. During the eighth and beyond centuries, descriptive literature on Rasa-Sastra, such as Kakshyaputa tantra and Rasa tarangini, were written. In Ayurvedic medicine, iron-containing minerals such as Kasisa (Ferrous sulphate), Makhika (Iron pyrite), and Gairika (Ochre) were utilised both internally and externally, with varying properties and applications dependent on their composition and attributes. These historical practises demonstrate Ayurveda's long-standing understanding of iron's medicinal usefulness. Iron compounds have been employed in Ayurveda to treat a variety of health problems. For example, Lauha bhasma is distinguished by its pungent (Tikta), sweet (Madhura), and astringent (Kashaya) flavours, as well as its sweet (Madhura) post-digestive impact. It has a cool potency and the attributes of dryness (Ruksha) and heaviness (Guru). Such iron-containing compounds are routinely used to treat a wide range of conditions, including anaemia (Pandu). Makhika (Iron pyrite) is commonly utilised in geriatric diseases, whereas Kasisa (Ferrous sulphate) is used to treat skin disorders, leucoderma, hair loss, anaemia, and parasitic infestations. Gairika (Ochre) is used to treat digestive and bleeding issues. It is crucial to note, however, that Lauha Bhasma should not be used alone; it should be paired with Parada Bhasma and/or Abhra Bhasma to avoid difficulties such as inertia (Jadata). Improperly prepared Iron Bhasma can cause a variety of side effects, including stomach and heart pain, as well as death. To ensure the safety and effectiveness of the treatment, it is recommended that white pumpkin, til oil, black gramme, sour meals, and alcohol be avoided during iron therapy. These practises highlight Ayurveda's rich historical record of using iron and its compounds as vital components of traditional medicine.[5] The researchers ran an internet search for Ayurvedic medications and discovered 25 websites selling a total of 673 distinct goods. 193 (84%) of 230 randomly selected

products for purchase, ranging from 37 different producers, were successfully purchased and analysed. Products that were no longer available or out of stock, supplier refusals after recognising the researchers, duplicates, and products meant for topical use were among the causes for unsuccessful orders. Ayurvedic medications with measurable quantities of lead, mercury, and/or arsenic were found to be 20.7% prevalent. The most frequent metal detected was lead, followed by mercury and arsenic. Importantly, there was no statistically significant difference in the proportion of metal-containing products manufactured in the United States vs India. Indian-made items, on the other hand, tended to have greater mercury contents, while those prepared utilising Rasa Shastra procedures were more likely to include metals and had higher median lead and mercury concentrations. Notably, whereas several of the manufacturers claimed to follow Good Manufacturing Practises or conduct metal testing, these assertions were not associated with a lower incidence of harmful metals in their products. The study also found that several of the analysed items would result in metal ingestions exceeding regulatory levels if taken as directed by the manufacturer, with Indian-made Rasa Shastra medications offering the greatest danger. In conclusion, the study found a disturbing incidence of hazardous metals, including lead, mercury, and arsenic, in Ayurvedic medicines, regardless of their country of origin. While items manufactured in the United States typically had lead at amounts less than 25 g/g, pharmaceuticals manufactured in India contained both lead and mercury at higher concentrations, exceeding 104 g/g. The study highlighted the possible health concerns linked with these metals in Ayurvedic medicines, as all metal-containing items would result in daily metal ingestions that exceeded at least one regulatory standard. Rasa Shastra remedies made in India posed the highest risk, with typically extraordinarily high lead and mercury contents. It was also discovered that manufacturer promises of Good Manufacturing Practises or metal testing did not always imply safer products. Overall, the findings expressed serious concerns regarding the safety and quality of Ayurvedic medications on the market, emphasising the industry's need for greater regulation and quality control. This study examines approximately 21% of commercially manufactured Ayurvedic medications purchased online and discovered a significant incidence of hazardous heavy metals such as lead, mercury, and arsenic. Surprisingly, the presence of these potentially hazardous metals did not differ considerably between products manufactured in the United States and those manufactured in India. Rasa shastra remedies, which are frequently manufactured using complex methods incorporating numerous metal forms, were found to be more than twice as likely to contain detectable metals. Given that all metal-containing items surpassed permissible daily metal consumption

levels, these findings raise concerns regarding the safety of Ayurvedic medications. Importantly, some Rasa Shastra medicines prepared in India may result in lead and mercury ingestions 100 to 10,000 times higher than safe limits. To preserve public health, the study emphasises the importance of rigorous oversight and quality control within the Ayurvedic medicine sector. The study found that, despite assurances made by Ayurveda practitioners in India that Rasa Shastra medications are correctly prepared and safe, documented case reports of metal poisoning contradict these claims. Many people who use Ayurvedic remedies, both in India and around the world, may suffer unrecognised or subclinical metal toxicity, emphasising the significance of monitoring and regulating these products. The study emphasised the critical need for observational research to evaluate whether the use of Rasa Shastra and non-Rasa Shastra drugs contributes independently to increased metal load, particularly lead, in patients. Finally, these findings support proposals for tougher controls, such as government-mandated daily dose limitations for hazardous metals in all dietary supplements, as well as requiring producers to certify compliance through independent third-party testing. This is critical for safeguarding the public's health from potential health concerns linked with the use of Ayurvedic medicines and other dietary supplements.[6] The antioxidant activity of four different plant extracts used in Ayurvedic medicine was investigated in a study. The extracts were evaluated for their ability to inhibit lipid peroxidation (LPO) induced by gamma radiation in microsomes and to protect the antioxidant enzyme SOD in mitochondria. The findings demonstrated that the antioxidant activity of various extracts varied. Specifically, AP4 was more effective than AP3 > AP2 > AP1 in suppressing LPO and protecting SOD. This implies that all of the extracts have antioxidant properties, although their efficiency differs. Scavenging of reactive oxygen and nitrogen free radicals is one mode of action for antioxidants. The extracts were examined for their capacity to scavenge DPPH radicals, a stable free radical, to further establish their antioxidant activity. Only AP4 and AP3 demonstrated substantial activity in this case, indicating the presence of chemicals such as polyphenols that readily give electrons or hydrogen. Additional research on the reactivity of ABTS radicals backed up these findings, with AP4 exhibiting the highest level of ascorbate equivalents, indicating a mixture of easily oxidizable chemicals, including polyphenols. AP3 also shown significant antioxidant activity, although AP2 and AP1 displayed negligible reactivity, which could be attributed to the presence of other chemicals with lesser antioxidant efficacy. These findings emphasise the broad antioxidant capacity of natural extracts, particularly those enriched in polyphenolic chemicals, which play an important role in oxidative stress resistance in vitro. The researchers used a variety of

approaches to quantify the antioxidant capacity of these natural extracts, shedding light on the importance of polyphenolic components like gallic acid, catechins, and ellagic acid in giving excellent antioxidant activity. Notably, AP4 and AP3 had the highest levels of antioxidant activity, whereas bile acids and carbohydrates in extracts like AP2 and AP1 may also have antioxidant properties, albeit less efficiently, and their mechanism of action may differ from that of polyphenolic constituents. This study emphasises the significance of understanding the antioxidant capacity of various natural extracts and provides vital insights into the variable efficacy of these traditional Ayurvedic medications in fighting oxidative stress via various mechanisms.

Table 4. Prevalence and Median Concentrations of Lead, Mercury, and Arsenic in Ayurvedic Medicines[a]

	All Products (n = 193)	US-Manufactured Products (n = 115)	Indian-Manufactured Products (n = 77)	*P* Value[b]	Rasa Shastra Medicines (n = 32)	Non–Rasa Shastra Medicines (n = 158)	*P* Value[c]
Prevalence, % (95% CI)							
Lead, mercury, or arsenic	20.7 (15.2-27.1)	21.7 (14.6-30.4)	19.5 (11.3-30.1)	.86	40.6 (23.7-59.4)	17.1 (11.6-23.9)	.007
Lead	19.2 (13.9-25.4)	20.9 (13.9-29.4)	16.9 (9.3-27.1)	.58	40.6 (23.7-59.4)	15.2 (10.0-21.8)	.002
Mercury	4.1 (1.8-8.0)	2.6 (0.5-7.4)	6.5 (2.1-14.5)	.27	9.4 (2.0-25.0)	3.2 (1.0-7.2)	.13
Arsenic	1.6 (0.3-4.5)	2.6 (0.5-7.4)	0	.28	3.1 (0.1-16.2)	1.3 (0.2-4.5)	.43
Concentration, median (range), µg/g							
Lead	7.5 (2.5-25 950)	7.5 (3.0-20.5)	11.0 (2.5-25 950)	.31	11.5 (2.5-25 950)	7.0 (3.0-20.5)	.03
Mercury	103.8 (24.5-28 200)	25.5 (24.5-34.5)	13 050 (47.5-28 200)	.04	20 800 (13 050-28 200)	34.5 (24.5-160)	.04
Arsenic	27.0 (10.5-27.5)	27.0 (10.5-27.5)			27.5	18.8 (10.5-27.0)	.54

Abbreviation: CI, confidence interval.
[a] The median metal concentration presented is for medicines with detectable amounts of the respective metal.
[b] Comparison between US- and Indian-manufactured products.
[c] Comparison between rasa shastra and non–rasa shastra medicines.

Experiment for Comparing Antioxidant Activity of Individual Herb Component in Ayurvedic Medicine.

CHEMICALS

Aldrich Chemicals in the United States provided chemical reagents such as 2,20-Diphenyl-1-picrylhydrazyl (DPPH) and 2,20-azinobis(3-ethylbenzothiazoline-6-sulfonate) (ABTS2). Other compounds, including thiobarbituric acid (TBA), butylated hydroxytoluene (BHT), ascorbic acid, and epinephrine, were procured from Sigma compounds in the United States, guaranteeing the greatest purity attainable. Nitrous oxide (N2O) and oxygen (O2) were obtained from Indian Oxygen Ltd. in Mumbai and were of IOLAR grade purity. Nano pure water was used to prepare aqueous solutions, which was manufactured using a Branstead nano pure purification system, and fresh solutions were prepared for each experiment. All experiments were repeated at least twice, and the errors reported are the mean deviations.

ISOLATION OF MICROSOMES AND MITOCHONDRIA

Male albino Wistar rats weighing 180 to 200 grammes were used to harvest rat liver mitochondria and microsomes. The animals were decapitated, and their livers were quickly removed and rinsed with an isolation media of ice-cold 0.25 M sucrose with 10 mM Tris-HCl at pH 7.4. In this isolation medium, a 10% liver homogenate was created. Mitochondria were separated using differential centrifugation, then washed twice with 10 mM phosphate buffer at pH 7.4, and resuspended in the same buffer. Microsomes were separated from the supernatant produced following mitochondrial separation by differential centrifugation, washed, and suspended in a 10 mM phosphate buffer at pH 7.4. All processes were carried out at temperatures ranging from 0 to 4°C. The Lowry method was used to determine protein concentration (Lowry et al., 1951). Microsomes and mitochondria were diluted with pH 7.4 phosphate buffer throughout the experiment.

METHOD OF EXTRACTION

The plant extract was made by swirling a fine powder with a mesh size of 20 in 8 parts distilled water that was heated to a temperature of 70-80°C for 2 hours. The liquid extract that resulted was then filtered using a sieve with a mesh size of 200. The liquid was then concentrated to two parts using a rotary vacuum evaporator, and the concentrated liquid was spray dried to obtain a dry powder of the extract. The concentrations of the solutions in this study were such that they remained clear and free of any suspensions, showing full solubility in the buffer solution. These concentrations were expressed in milligrams per millilitre. An aqueous solution of the extract at pH 7.4 was newly made shortly prior to the experiment for integration of the plant extracts into the microsomes. This solution was then applied to the microsomes or mitochondria, and the extract concentration was adjusted as needed. The extract concentration in microsomes is given in milligrams per millilitre.

GAMMA – RADIATION

The gamma (g)-radiolysis of rat liver microsomes was used to study lipid peroxidation (LPO). The researchers performed steady-state g-radiolysis with a 60Co gamma source at a dosage rate of 9.1 Gy/min, as determined by standard Fricke dosimetry. The effects of g-radiation on lipid peroxidation were studied at different doses in N2O-purged microsomal solutions, both in the absence and presence of the plant extract, all at physiological pH 7.4 in a phosphate buffer. The quantification of LPO extent was determined by measuring the levels of thiobarbituric acid reactive substances (TBARS) using a solution containing 15% w/v

trichloroacetic acid, 0.375% w/v TBA, 0.25 N hydrochloric acid, and 0.05% w/v BHT as the TBA reagent, with absorbance measurements taken at 532 nm, using an absorption coefficient (e532) of 1.56 x 10^5 M^-1 cm^-1, as specified in previous references (Sreejayan et al., 1997; Khopde et al., 2000).

ESTIMATION OF SUPEROXIDE DISMUTASE ENZYMATIC ACTIVITY

The study looked into the protection of superoxide dismutase (SOD) against g-radiation-induced damage in rat liver mitochondria isolated using the previously published technique. In both the presence and absence of the plant extract, rat liver mitochondria suspended in oxygenated phosphate buffer at a concentration of 2 mg protein/ml were exposed to a total dose of 570. Control studies in identical glass vials were also carried out to assess SOD activity in the absence of radiation exposure. SOD levels were measured in both control and irradiation samples using a method described in the literature (Sum and Zigman, 1978; Khopde et al., 2001; Kamat et al., 1999). In a spectrophotometric cell, a 1 ml solution containing sodium carbonate buffer (50 mM, pH 10), the mitochondria sample with 40 mg protein, and 5 mM epinephrine was put. Changes in absorbance at 320 nm were measured over 6 minutes in comparison to a blank sample containing the same solution but lacking epinephrine. The difference in absorbance between the standard and the sample was used to compute SOD units per milligram of protein.

ESTIMATION OF ANTIOXIDANT CAPACITY OF THE EXRACTS BY CYCLIC VOLTAMMETRY AND PULSE RADIOLYSIS

The Ecochemie Autolab, PGSTAT 20 Model was used to record cyclic voltametric traces of the extract solutions over a voltage range of -0.25 to 1.2 V at a scan rate of 50 mV/s. A three-electrode system was used, with Ag/AgCl serving as the reference electrode, glassy carbon serving as the working electrode, and platinum wire serving as the counter electrode. A 25 ml sample solution and 0.1 M KCl were added to the cell, and the pH was adjusted to 7 with a phosphate buffer. To avoid undesired deposits, the working electrode was cleaned on a regular basis. The antioxidant ability of ascorbic acid was also evaluated by measuring its reactivity to ABTS+ radicals. These studies were carried out using pulse radiolysis techniques, and detailed procedures are available elsewhere (Guha et al., 1987). These experiments used 50 ns electron pulses generated by a 7 MeV linear electron accelerator, and the reaction kinetics were studied using spectrophotometry.

DPPH ASSAY

To test the extracts' DPPH radical scavenging capacity, 1 ml of a 500 mM DPPH solution in methanol was mixed with an equal volume of the extract solution in phosphate buffer (pH 7.4). After carefully mixing the mixture, it was placed in the dark for 20 minutes. The absorbance at 517 nm was monitored while the extract concentrations were varied. To assess the absorbance of DPPH prior to its contact with the extract, a blank experiment was performed. The concentration of the extract in mg/ml at which the absorbance at 517 nm reduced to half of its initial value was identified as the extract's IC50 value, demonstrating its DPPH radical scavenging activity.[7]

Description of Two Ayurvedic Products: Arishta and Asava.

PREPARATION OF ARISHTA AND ASAVA

The method of preparing asava & arishtas is known as sandhana kalpana in Ayurveda. General Methods used in the Extraction of Medicinal Plants in asava and arishta are infusion and decoction.

INFUSION

In traditional Indian medicine, Ayurveda, the preparation of arishta and asava involves the use of simple tools such as earthen pots, porcelain jars, and stirrers. Fresh infusions are created by macerating medicinal herbs in cold or boiling water to create dilute solutions of these plants' active components. The ingredients used to make arishta and asava are divided into four categories: primary herbs that are essential for the medicine's therapeutic effects and give the preparations their names, flavouring agents that enhance both taste and provide additional pharmacological actions, a fermentation initiator that kickstarts the fermentation process, and a sugar medium required for fermentation. Asoka (Saracaasoca) is the major herb in Asoka Rishta, which is supplemented by Cuminum cyminum, Santalum album, Zingiber officinale, Woodfordia fruticosa, and jaggery. Kanaka (Datura metel) is the principal herb in Kanakasava, and it's flavoured with Piper longum and Zingiber officinale. Woodfordia fruticosa is highly appreciated in herbal medicine and is widely used in asava and arishta formulations. While all parts of the plant offer medical benefits, its blossoms are in high demand in both domestic and international herbal medicine markets. These flowers are noted for their pungent, cooling, and medicinal capabilities, and they are used to treat a variety of health issues such as thirst, dysentery, leprosy, blood diseases, women's health difficulties such as menorrhagia and leucorrhoea, and even toothaches. This highlights the

vast and diversified usage of natural components in the preparation of Ayurvedic medicines such as arishta and asava, which combine traditional wisdom and natural cures.

DECOTION

The mentioned procedure comprises the extraction of therapeutic plants in Ayurveda, which are specifically used for ingredients that are water-soluble and heat-stable. In this procedure, a predetermined amount of crude medication is cooked in a predetermined volume of water for a predetermined amount of time. The mixture is allowed to cool after boiling before being strained or filtered. This process is primarily used to make Ayurvedic extracts known as "quath." Typically, the initial ratio of crude medication to water is predetermined, such as 1:4 or 1:16. Boiling reduces the fluid to one-fourth of its initial volume as the extraction advances. The concentrated extract is then filtered and can be utilised directly or further processed for its intended medical application.

COLLECTION OF PLANT MATERIAL AND PREPARATION BEFORE FERMENTATION

Ayurvedic medications are made using a variety of precise processes and specialised equipment. To remove impurities, medicinal substances such as roots, leaves, or barks are thoroughly cleansed and rinsed. To extract the juice from fresh plants, it is washed, pulverised, and pressed, whereas dried herbs for asavas are coarsely crushed and mixed with water, as well as specific amounts of honey, jaggery, or sugar. A decoction for arishtas is made by boiling herbs in a certain amount of water, using clean, transparent, and potable water. After obtaining the extracts, it is critical to verify the purity of the added sugar, jaggery, or honey, with aged jaggery being recommended for its digestive characteristics. To avoid sedimentation during medicine production, coarsely crushed flavouring ingredients are incorporated into the sweetened extract. The amounts of avapa, which are powdered herbs added at the end, should be carefully monitored. Traditional earthen pots or jars are used for fermentation, with fractures and weak points avoided. To avoid leaks, the interior of these vessels is cleaned and smeared with cow's ghee. To allow for foaming and gas formation during the fermentation process, a portion of the container stays unfilled. For large-scale production, modern equipment such as mills, pulverizers, and mixing machines are used, and decoctions are made in steam jacketed boilers heated by superheated steam. Large wooden vats with airtight covers facilitate fermentation in industrial settings, and motorised filter presses with filter sheets ensure the removal of suspended particles to isolate clean medicinal

solutions. Throughout the manufacturing process, these careful methods ensure the purity and efficacy of Ayurvedic medicines.

INOCULUM

The next stage in preparing Ayurvedic medicine is to pour the sweetened and flavoured medicinal extract into a pot or jar, filling it to three-fourths of its capacity. It is critical to leave some empty space to allow the rising fermenting liquid, which generates froth and a substantial amount of gases throughout the fermentation process. This precaution protects the medium from harming or overflowing the container. The inclusion of an inoculum to induce fermentation is the next critical step. The presence of fermenting microorganisms, notably yeasts, is required for fermentation. Yeasts from dhataki flowers, which include wild yeast species, are used in the manufacture of alcoholic Ayurvedic remedies. These nectariferous blooms are high in tannins, making them perfect for yeast growth. The dry nectariferous portion of these blooms contains yeast spores. After adding the flowers to the container, the contents are thoroughly mixed to disperse the yeast inoculum. In the absence of dhataki flowers, other substances such as honey and resins (gum) may include wild yeasts. Mahua flowers, honey, or resins can all be used to kickstart the fermentation process. Yeasts multiply quickly by division over a short amount of time. Once the vessel has been filled and inoculated, it must be properly sealed. A long fabric ribbon smeared with clay on one surface is wound around the rim of the jug and its lid to seal it. When sealing, line the container's rim and lid with the blank side of the ribbon, while the clay-covered side should face outward. The vessel is then sealed and placed in a dark location with minimal air circulation. It can be stored in a grain store, buried within a grain mound, or even sunk into the ground. Soft packing materials, such as straw, are used to protect the vessel from external influences. These rigorous methods ensure that Ayurvedic medicines ferment and mature under controlled settings, keeping their quality and efficacy.

FERMENTATION PROCESS

The fermentation time in Ayurvedic medicine preparation varies according to the season. Fermentation takes around 6 days during the autumn and summer seasons, 10 days during the winter season, and 8 days during the rainy season and spring. The drug is opened and filtered after a month of undisturbed fermentation. If more sedimentation occurs, it is allowed to settle for a few days before being filtered again. Fermentation normally takes 7 to 10 days in hot tropical climes, but cooler regions with reduced biological activity may require a longer

period of 30 days. In the past, fermentation was occasionally done in a heap of whole grain specific to the season. A simple match-box approach is employed to validate fermentation, relying on the release of carbon dioxide during the process. Woodfordia fruticosa, which is utilised as an inoculum for fermentation, plays an important role in this dosage form that goes beyond its original purpose.[8]

Table 6: Important Formulation of Asava And Arishta Used In Treatment Of Different Diseases.

S. No	Name of asava / arishta	Disease treated by asava/arishta
1	Ashokarishta	Menstrual cycle regulator, especially to control excessive bleeding for prolonged periods during menstrual cycle, urinary disorder
2	Dashamularishta	Normalization of physiological processes after childbirth in women; anti-inflammatory, Piles, jaundis, sterility in female, Pneumonia,
3	Aravindasava	Pediatric tonic, Appetizer
4	Arjunarishta	Cardiotonic
5	Drakshasava	General tonic, influenza, Blood toner/nourishment
6	Kumaryasava	Liver disorders, piles, constipation, enlargement of spleen, cooling effect, Endocrinal deficiency, Blood toner/nourishment
7	Lohasava	Anemia, Piles, spleen disorder, diabetes, Ascites
8	Draksharishta	Constipation
9	Saraswatharishta	Seminal weakness
10	Mrithasanjeevaniarishta	Sexual stimulating tonic, Weakness
11	Sarivadyarishta	Syphilis
12	Chandanasava	Autoimmune disease
13	Aswagandharishta	Weakness, appetizer
14	Mahamanjisthadyarishta	Rejuvenator
15	Chandanasava	Cooling Effect, Spermatorrhoea, appetizer
16	Khadirarishta	Cancer
17	Kutajarishta	Fever
18	Devadarvyarishta,	Diabetes
19	Amritarishta / Amritarishta	Malaria
20	Sirisharishta	Poisonous bites
21	Srikhandasava	Alcoholism
22	Vasakasava	Leprosy
23	Ahifenasava/ Muktakarishta	Cholera
24	Aragwadharishta/Chitrakasava	Leucoderma
25	Vidaryadyasava	Body Ache
26	Patrangasava	Spermatorrhoea
27	Vasasava/ Punarnavarishta	Oedema
28	Loharishta/ Lodharasava	To reduce obesity
29	Balarish/ Devadarvyarishta	Rheumatism

Study of Ayurvedic Medicine – Clitoria ternatea

BOTANY AND PHARMACOGNOSY OF CLITORIA TERNATEA

The described plant is a beautiful perennial climber that grows in the wild and in gardens, reaching a height of 2 to 3 metres. It grows in tropical places worldwide, below 1600 metres, and produces stunning blue or white flowers like a conch shell. The leaves of the plant are ovate or oblong in shape, 2 to 5 centimetres long, and have rubiaceous stomata with wavy cell walls on both the upper and lower epidermis. The leaves also have multicellular trichomes, which consist of two smaller basal cells and two larger terminal cells. Transverse

sections of the leaves show a dorsiventral structure, with papillose lower epidermal cells in the midrib area. Along the veins, Prismatic calcium oxalate crystals can be found. Solitary, axillary, papilionaceous blooms in white or vivid blue with a yellow or orange centre are produced by the shrub. Its pods are flat, nearly straight, and strongly beaked, with 6 to 11 yellowish-brown or blackish seeds that are sub globose or oblong. The root system is made up of a strong taproot, a few branches, and slender lateral roots, with the root being woody and cream white in colour. Fresh root tastes slightly harsh and caustic. Transverse root sections reveal the presence of phloem, phellogen, phelloderm, cortex, and central core, each with distinct properties, such as the presence of calcium oxalate crystals in some cells. There is no information available on prospective adulterants or species that could replace this plant, emphasising the ornamental climber's distinctive traits.

PHARMACOLOGICAL ACTIVITIES OF CLITORIA TERNATEA

Clitoria ternatea (CT) has been subjected to rigorous pharmacological testing, demonstrating a wide range of possible therapeutic activities. It has neuropharmacological effects, including increasing acetylcholine content and acting as a nootropic, antistress, anxiolytic, antidepressant, anticonvulsant, tranquillizing, and sedative drug. These characteristics validate its historical use in the Ayurvedic medical system for treating central nervous system (CNS) diseases. CT also possesses antibacterial, antipyretic, anti-inflammatory, analgesic, diuretic, local anaesthetic, antidiabetic, insecticidal, blood platelet aggregation inhibition, and vascular smooth muscle relaxing effects. The broad therapeutic potential of CT, as evidenced by the different known pharmacological activities, emphasises its importance in traditional Indian medicine while also highlighting areas where our understanding is still inadequate. Clitoria ternatea has effects on many body activities such as on learning and memory, on general behaviour, on nootropic and anxiolytic activity. It also has many other activities like antidepressant, tranquilizing, sedative, anticonvulsant, anti-stress, anti-inflammatory, analgesic, antipyretic, antidiabetic, local anaesthetic, antimicrobial and platelet aggregation inhibition. These effects highlight the therapeutic potential of Clitoria ternatea.

Medicinal Uses in Asian Indian Medicine

The plant known as 'Sankhapushpi' in Ayurveda is obtained from the roots and seeds of Clitoria ternatea (CT). This medicinal plant is used as a nerve tonic and has alterative and laxative qualities. Its leaves and roots are used to cure a variety of diseases, including body aches and urinogenital disorders, as well as an anthelminthic and antidote for animal stings.

The white-flowered CT is considered more therapeutically active and preferable of the two types. The blue-flowered variation is frequently employed in place of the white-flowered one. The roots have an acrid and bitter taste and are thought to have purgative, laxative, and diuretic qualities. They are used to treat illnesses like indigestion, constipation, fever, arthritis, and eye problems. The roots are also used to treat ascetics, swelling of the abdominal viscera, sore throat, skin problems, and chronic bronchitis, despite the fact that their purgative actions might cause griping and pain. These roots are also used as a general tonic for youngsters, along with honey and ghee, to improve mental abilities, physical strength, and complexion. They can be used to treat epilepsy and insanity. The root juice of the white-flowered variety is used to treat hemicrania, while the decoction or powdered root is used to treat rheumatism and ear ailments. When combined with ginger, the powdered seeds act as a laxative, albeit they may produce griping in the lower belly. These seeds are indicated for colic, dropsy, and abdominal visceral hypertrophy. In addition, they are utilised to treat inflamed joints. In India, the plant's root, stem, and bloom are used to treat snakebites and scorpion stings.[9]

Ayurvedic Concept of Cancer

The ancient Indian medical writings Charaka and Sushruta Samhita, which date back about 700 BC, offer a unique viewpoint on the understanding and classification of neoplasms, which are analogous to cancer in modern words, within the framework of Ayurveda. These texts classify neoplasms based on the principles of doshas, which reflect the three major body systems—Vata, Pitta, and Kapha. In Ayurveda, the balance of these doshas is considered crucial for wellness. Tridoshic tumours are categorised as malignant neoplasms due to a breakdown of coordination among all three major bodily humours. This imbalance is at the heart of the morbid condition associated with these tumours. The Ayurvedic approach to treatment focuses on restoring Vata, Pitta, and Kapha balance. The first category includes obvious malignancies, such as arbuda and granthi, as well as sarcomas, leukaemia, mouth cancer, and incurable or malignant ulcers. The second category includes disorders that are cancerous or likely to be cancerous, such as lip growths, thyroid tumours, tridosaja gulmas, and abdominal tumours such as carcinomas or lymphomas. The third category comprises cancerous disorders such as erysipelas, incurable jaundice, intractable leukorrhea, and intractable sinusitis. In traditional medicinal practises, the Ayurvedic classification is based on clinical symptoms associated to tridoshas, giving a holistic approach to diagnosing and treating neoplastic disorders.

Source of Anti-Cancer Drugs from Ayurvedic Medicine

Some of the herbs commonly used in Ayurveda Figure 4. The active components of these herbs, which have anticancer activity, and their molecular targets are described below (Figures 2 and 3).

Ayurvedic Agents as Chemosensitizers and Radiosensitisers

The sentence emphasises the difficulties involved with tumour resistance to standard cancer therapies, notably radiation and chemotherapy. While existing medications such as hydroxyurea, 5-fluorouracil, and cisplatin are used for radiosensitization, their toxicity is still a major problem. Notably, Ayurvedic medicine offers a potential alternative, since several safe and non-toxic medicines listed in this traditional system have been shown to work as sensitizers, increasing the efficacy of cancer chemotherapy and radiotherapy. Preclinical investigations have shown that compounds derived from several medicinal plants, such as plumbagin, tetrandrine, withaferin-A, curcumin, perillyl alcohol, and berberine, have radiosensitizing properties. These medicines work by interfering with drug efflux pumps, inhibiting proteasome activity, modulating apoptotic pathways, and downregulating survival genes, providing a multimodal strategy to overcome chemoresistance and radiosensitivity. Furthermore, the passage mentions certain Ayurvedic treatments that have shown promising anticancer and radiosensitizing properties, such as Withania somnifera (Ashwagandha) and Emblica officinalis (EO). Withaferin A, an active component of Ashwagandha, has demonstrated considerable radiosensitizing effects while causing little systemic toxicity, highlighting its promise as a natural and safe adjuvant to cancer therapy. Similarly, the fruit pulp of Emblica officinalis has been shown in animal experiments to have radioprotective qualities, lowering fatality rates and minimising weight loss in irradiated animals. These findings imply that Ayurvedic medicine may provide useful insights into novel and less hazardous techniques to improving the efficacy of cancer treatments, thereby tackling the long-standing issue of resistance in oncology.[10]

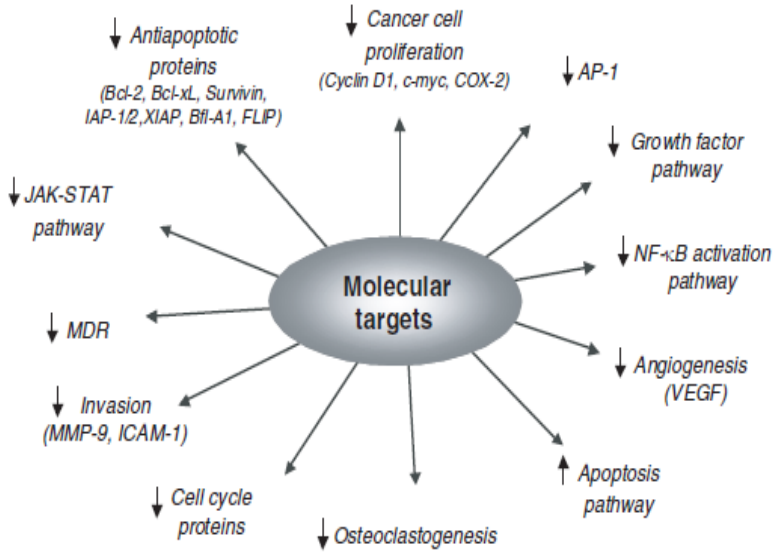

Figure 2. Molecular targets of Ayurvedic drugs.

AP: Activated protein; COX: Cyclooxygenase; IAP: Inhibitor of apoptosis protein; ICAM: Intercellular cell adhesion molecule; JAK: Janus kinase; MDR: Multi-drug resistance; MMP: Matrix metalloprotease; NF-κB: Nuclear factor kappaB; STAT: Signal transducer and activator of transcription; VEGF: Vascular endothelial growth factor; XIAP: X-linked inhibitor of apoptosis.

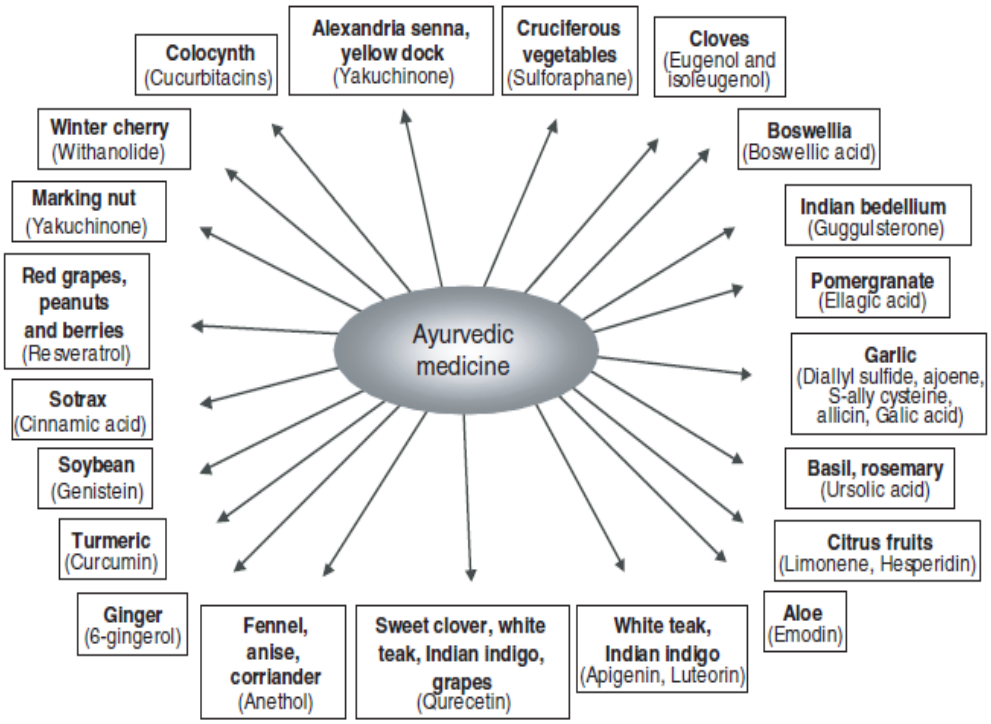

Figure 3. Active components from Ayurvedic medicine.

Traditional Ayurvedic medicine to modern medicine: identification of targets for suppression of inflammation and cancer

Figure 4. Sources of Ayurvedic drugs.

Major Problems with Clinical Trials of Ayurvedic Medicine

The chapter covers the difficulties associated with using Ayurvedic Herbal Medicinal Products (HMPs) as well as the difficulty involved in conducting clinical studies for traditional/herbal treatments. The lack of severe regulation for Ayurvedic HMPs, which are frequently sold as dietary supplements under the Dietary Supplement Health and Education Act (DSHEA), is one main source of worry. Because this regulatory framework does not require proof of safety or efficacy, cases of heavy metal intoxication, notably lead toxicity, have been described in conjunction with Ayurvedic HMPs. There have been numerous reports of heavy metal poisoning, raising questions about the safety of these goods. Conditions such as status epilepticus, fatal newborn encephalopathy, congenital paralysis, sensory-neural deafness, and foetal developmental delay are among the potential health hazards. The chapter goes on to discuss the difficult challenges of conducting clinical trials for traditional herbal remedies. The difficulties of preserving identical qualities such as colour, smell, and taste in both active and control groups makes double-blind randomised trials difficult to implement. The unique properties of herbal research medications complicate the use of placebos, and ethical difficulties arise when using placebos instead of available effective remedies. The standardisation of chemicals in formulations combining numerous plant extracts, the determination of "active" molecules in pharmacokinetic investigations, and the effect of storage conditions on the bioavailability of herbal medications are all challenges. Furthermore, the paragraph emphasises the often-overlooked relevance of Good Manufacturing Practises in Ayurvedic product production, as well as the need for vigilance against adulteration and substitution. Furthermore, the paragraph emphasises the distinctive aspects of Ayurvedic treatment, such as the emphasis on the patient's psychosomatic constitution (Prakriti) determining the efficacy of herbal remedies. Additional obstacles are posed by the lack of standardised benchmark formulations and the heterogeneity in raw plant material due to regional and climatic conditions. Clinical studies are made more complicated by the holistic approach of many herbal systems, the integration of numerous therapies, and the possible impact of nutrition on treatment outcomes. The chapter closes by emphasising the need for well-controlled, double-blind clinical trials to show both safety and efficacy, especially considering the vast global market for herbal medications.

Status of Clinical Trials of Ayurvedic Medicine

Plants cannot be trademarked, prohibiting private pharmaceutical companies from investing in lengthy and costly clinical trials. The severe regulatory standards for establishing the safety

and efficacy of new medications in the United States need a lengthy and costly procedure lasting around 15 years and costing approximately $500 million. Due to the FDA's stringent requirements, only a few research firms are ready to spend the necessary time and financial resources. The regulatory framework, notably the requirement for efficacy demonstration, makes major clinical studies on herbal medicine economically prohibitive for private enterprises. If regulatory standards for efficacy were loosened, private enterprises might find it more feasible to invest in research focusing on herbal medicine safety and quality control. The paragraph does, however, mention that public money may still be required to verify herbal therapies, as pharmaceutical corporations may lack sufficient incentive to produce herbal solutions that could potentially replace patented medications. The offered argument emphasises the importance of generating more data, particularly for measuring the efficacy of herbal therapy. In the view of the majority, clinical trials are the gold standard for showing efficacy, and the paragraph says that without adequate investigations on human subjects, no valid conclusions regarding the efficacy and safety of herbal medicine can be reached. Furthermore, it highlights the existing lack of infrastructure for alternative and herbal medicine research, limiting efforts to perform comprehensive studies in this subject. Overall, the paragraph implies that lowering regulatory constraints and building suitable infrastructure are critical steps in encouraging private enterprise participation and advancing research on the safety and efficacy of herbal medicine.[11]

CONCLUSIONS

The examined publications highlight the complicated landscape of Ayurvedic medicine, covering problems ranging from safety and efficacy concerns to the integration of traditional practises into modern healthcare systems. The first set of issues is the difficulty of conducting clinical studies for Ayurvedic herbal remedies. The diversity of Ayurvedic formulations, which can involve various plant extracts with varied properties, makes it difficult to create control groups, placebos, and standardisation. Bioavailability, storage conditions, and noncompliance with Good Manufacturing Practises all hamper the dependability and reproducibility of clinical study results.

The safety problems are exemplified by lead toxicity connected with Ayurvedic Herbal Medicinal Products (HMPs). Heavy metal intoxication reports raise concerns regarding the quality control and regulation of Ayurvedic medicines, particularly when sold as dietary supplements under regulations that do not require proof of safety or efficacy. The lack of

standardised benchmarks, combined with variances in raw plant materials, necessitates a more stringent approach to product quality and safety. Furthermore, the different constitution of patients, impacted by the Ayurvedic idea of "Prakriti," adds a degree of complication, making consistent outcomes in clinical investigations difficult.

The second group of issues focuses on the larger context of herbal medicine research, including Ayurveda, as well as the limits of the present pharmaceutical paradigm. Extensive research on herbal therapy is hampered by the costly cost and time associated with pharmaceutical medication development, as well as the impossibility to patent plants. According to the passage, reducing regulatory standards for efficacy may stimulate private investment in research focused on safety and quality control, but public monies are still required for validation. The lack of infrastructure for herbal medicine research stymies progresses even more.

Finally, the essays emphasise the critical need for a paradigm shift in research methods and the incorporation of Ayurvedic medicine into the global healthcare system. While acknowledging the potential benefits of Ayurveda, the limitations stated, such as safety concerns, various formulations, and a lack of research infrastructure, highlight the need for a systematic and evidence-based approach. To confirm Ayurvedic basics and therapies, it is necessary to bridge the gap between traditional wisdom and current scientific methodologies. The desire for advanced research methodology, adherence to global standards, and the formulation of guidelines demonstrates a shared understanding of the importance of evolving Ayurveda as a scientifically validated and integrated system within the modern healthcare framework. To preserve the survival and advancement of Ayurveda in the face of changing healthcare demands, researchers, practitioners, and policymakers must work together.

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