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EDITORIAL

India's strength in traditional medicines lies in the plurality of systems, with each system having its unique approach to healthcare. Ayush systems i.e. Ayurveda, Siddha, Unani, Sowa Rigpa along with Homeopathy have demonstrated impressive growth over the last few years. Buoyed by institutional support, the regulatory streamlining has provided impetus for growth of the traditional medicine industry allied to all the systems. While Ayurveda and Yoga have gained global visibility, other systems of medicine enjoy strong usage within the respective geographical areas. For example, Siddha medicine, one of the oldest traditional healthcare systems, has its origins in Tamil Nadu where public and private Siddha enterprises offer healthcare solutions to a vast proportion of the population. Similarly, Homeopathy, with origins outside India, has been in popular usage and the Indian market for Homoeopathic products has shown substantial growth. Highlighting the research on historical contexts of expansion and development of these systems is imperative for academia and policy makers alike.

Even as these systems grow, addressing back-end and forward linkages become critical for their expansion. This includes procurement of raw materials on the one hand and effective export strategies in line with market requirements on the other. Most systems such as Ayurveda, Siddha and Unani are heavily dependent on medicinal plants as key raw materials. Amidst worldwide growth in the herbal medicine sector Ayush is faced with challenges of sustained availability of raw materials and biological resource depletion. Appropriate collection and cultivation practices, preservation of genetic resources, resilient supply chains, biodiversity mapping, R&D for germplasm conservation and use of synthetic biology are some important issues for consideration in the context medicinal plant sector. Growing global demand for herbal medicine has also driven exports of Ayush systems. The hallmark of the Ayush sector exports is that it has been catching up in line with the vertical value chain process and the herbal pharmaceutical segment would steer the export performance of Ayush exports in the coming years. Despite its accomplishments in recent years, Ayush exports have been an untapped sector with tremendous prospects for growth. Branding and traceability are some important factors driving growth of exports. As customers globally become conscious and demanding of information on sourcing of raw materials in food and herbal sectors, medicinal plants and their sourcing are being increasingly subjected to such scrutiny. Traceability tools whether through logistics or through standard certifications are being preferred as a brand

story to drive affinity. At the same time an understanding of demands of key markets is being leveraged by exporters for branding and product development of exports.

This Issue of Traditional Medicine Review throws light on the distinct systems of Ayush, key factors impacting their growth and strategies for increasing the export potential. R. Meena Kumari, S. Venkatesh and S. Ilanchezhiyan provide a comprehensive exploration of Siddha medicine's origins, principles, practices, and contemporary relevance, highlighting the system's unique contributions to addressing modern health challenges. Anil Khurana provides an overview of the Homeopathy sector in India. The question of quality and quantity of active phytochemical medicinal principles in the medicinal plants that are harnessed from the wild and that are harvested from crop farms is analysed by T.P Rajendran. Sanket Chavan analyses the price trends and market linkages of Ashwagandha across five key markets of Neemuch, Shivpuri, Dhamtari, Kolkata and Mumbai. Utkarsh Ghate and Hema Kulkarni highlight the key marketing strategies for greater market access to major export destinations. Finally, Dr Unnikrishnan Payyappalli reviews the book by Dr Bhushan Patwardhan titled, 'Genome to Om: Evolving Journey of Modern Science to Meta-science'.

I am sure readers will find this issue of Traditional Medicine Review useful in understanding the major health systems within Ayush, the challenges and prospects of these systems in the context of present trade and industry linkages.

Sachin Chaturvedi

A Brief History of Siddha Medicine

R. Meenakumari,* S. Venkatesh** and S. Ilanchezhiyan**

R. Meenakumari

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S. Ilanchezhiyan

Abstract: Siddha medicine, one of the oldest traditional healthcare systems, has its origins in Tamil Nadu embodies a holistic approach to health, integrating physical, mental, and spiritual well-being. The system is built on the four pillars of Vaatham (alchemy), Vaithiyam (medicine), Yogam (yoga), and Gnaanam (wisdom), which together provide a comprehensive framework for understanding and addressing human health. This article provides an exploration of Siddha medicine's origins, principles, practices, and contemporary relevance. It highlights the system's unique contributions to holistic health and its potential to address modern health challenges while preserving its rich cultural legacy.

Introduction

Traditional medicine systems that are truly Indian in its origin and development are Siddha and Ayurveda. However, discussions about Indian traditional medicine often focus heavily on Ayurveda, with Siddha being viewed as a regional variant practised in southern India. However, Siddha, an integral part of Ayush, possesses unique principles and practices. This system of medicine has demonstrated its validity in addressing pandemics and epidemics such as Dengue, Chikungunya, and COVID-19, serving almost every household in Tamil Nadu.

Institutions like the National Institute of Siddha serve as a testament to its relevance, catering daily to around 2,000 individuals seeking alternative healthcare solutions after being failed by other medical systems. Beyond this, countless individuals benefit from government-run Siddha hospitals, primary healthcare centers (PHCs), and private practitioners. Initiatives such as the Amma Magaperu Sanjeevi Pettagam (AMSP), a Siddha medicine kit aimed at reducing maternal and infant mortality rates, which is a specific quantitative goal of National Health Policy - 2017 while enhancing the

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health of women and children, underscoring the system's societal impact. Now more than ever, there is a need to emphasise the rich history and contributions of Siddha medicine.

This narrative aims to highlight the unique aspects of the Siddha tradition, explore its parallels with Ayurveda and shed light on the socio-cultural exchanges in the Indian subcontinent that may have influenced the evolution of both systems to their present forms. Several classical texts have been referred to. These texts have been included as part of references for further details.

Definition of a Siddha

The concept of a Siddha is as elusive and esoteric as the Siddhars themselves. A Siddha is not merely an individual but a state of consciousness, awareness, realisation, and unity with all existence. The heterogeneity within the Siddhar tradition makes defining a Siddha challenging. To aid this discussion, we can refer to a poem by Siddhar Pattinathar, which provides valuable insights into the essence of a Siddha.

> "Fleeting like ghost, lying like a corpse,
>
> Eating all the alms like a dog, labouring like a fox,
>
> Treating women like mothers, humbly conciliating all as kin,
>
> The enlightened remain a child, you see".
>
> Siddhar Pattinathar, poem 33[1]

SiddhaS, striving to alleviate the karma of all beings, wanders like a ghost, detached from possessions and indifferent to the day, night, or seasons. They rest like a corpse, unconcerned with surroundings or needs, and accept food indiscriminately, like dog consuming alms. Tirelessly labouring like a fox for the well-being of humanity, they remain, despite their austere practices, a symbol of purity and childlike innocence.

Contrary to popular belief, the Tamil word Siddha does not stem from Siddhi (accomplishment or supernatural powers). Instead, its root lies in Chith, which denotes awareness or consciousness—particularly the awareness of one's true self. Therefore, a Siddha is one who has realised their true self.

Distinguished Features of the Siddhars

Unlike many other traditions that portray their central figures as perfect beings or demi-gods, the Siddha tradition distinguishes itself as a group of pragmatic individuals who never claimed perfection but were always evolving and striving towards it. Each Siddhar's poem reflects this ongoing evolution. To fully understand this, one must engage deeply with the works of a particular Siddha. Similarly, the Siddhars advocated for self-improvement, rather than devotion (Bhakti), as the path to liberation (Mukthi).

In contrast to other philosophical traditions that view the physical body as transient and often deem it vulgar, deceptive, or insignificant, the Siddha tradition holds the body in high regard, seeing it as a tool for gaining knowledge and achieving self-improvement. With this understanding, the Tamil Siddhars sought to make the body eternal through the four pillars of Siddha: Vaatham, Vaithyam, Yogam, and Gnaanam. Vaithyam, a key aspect of the Siddha tradition, is what we now recognise as Siddha medicine.

Unlike other traditions that consider liberation to be the transcendence of the body, the Siddhars viewed death as akin to slumber, from which one could awaken at

will. Through the tools and techniques they developed to alter the transient nature of the body, they gained the ability to transcend both, the physical nature of the body and the physical laws of nature.

"Death is sinking into slumbers deep;

Birth again is waking out of sleep"

Thirukural 339

Philosophical Insights on Siddhis

The Siddhis (meaning accomplishments), eight in number, are regarded as by-products of the Tamil Siddhars' pursuit of self-liberation. The Siddhars were neither charlatans nor conjurors; their extraordinary feats were simply the natural outcomes of their profound spiritual endeavours and were never considered the ultimate goal.

However, to connect with the masses and inspire them, Siddhars occasionally demonstrated miraculous feats, known as Attama Siddhis (the eight great accomplishments) in Tamil. These Siddhis can also be interpreted metaphorically, representing deeper philosophical insights rather than mere physical phenomena.

The Attama Siddhis are as follows:

- Anima: Reducing one's physical self to the size of an atom
- Mahima: Growing one's physical self to an incredibly large size
- Garima: Making one's physical self so heavy as immovable by others
- Laghima: Becoming almost weightless
- Prapti: Being able to go/travel wherever one wants
- Prakamyam: Being able to obtain whatever one wants
- Isatuvam: Possessing lordship
- Vasituvam: Being able to control the minds of others

Mukthi or Liberation

Across India, numerous traditions have explored the concept of Mukthi (liberation) and regarded it as the ultimate goal of human existence. The Siddha tradition aligns with this belief but offers a distinct perspective on its meaning. While many revered Indian traditions define Mukthi as a spiritual union with the supreme, the Tamil Siddhars viewed it differently. For them, Mukthi is the attainment of ultimate awareness, and one who achieves this state of awareness is, in essence, the supreme being.

"The effect of goodly tapas In past performed,

Can with knowledge In present be discerned;

Self-knowledge is knowledge true,

The rest is but knowledge demented".

Thirumanthiram, poem 2318

The profound knowledge that the Siddhars speak of is the knowledge of the Self. This awareness of the self and the ability to perceive the cosmos as an extension of oneself is what defines a Siddha. This state of consciousness is referred to as Chith by the Siddhars. One who has unlocked Chith is called a Chiththar—a Siddha.

In classical Tamil, Chith, also known as Arivu (knowledge or awareness), is the root of the term Arivar, the name used in ancient Tamil texts to describe the Siddhars.

A unique aspect of the Siddha tradition is the Siddhars' deep desire to share their knowledge and the bliss they attained from it with all levels of society. This inclusivity is evident in the following verse by Siddhar Thirumoolar, emphasising their mission to make enlightenment accessible to everyone.

> *"Bliss To Humanity All the world may well attain the Bliss I have;*
>
> Who hold firm to the Heavenly secret the Books impart,
>
> Who chant the hymns that thrill the flesh And swell the heart,
>
> They, sure, take their place in foremost rank"
>
> Thirumanthiram, poem 85.

The Siddhars' pursuit of liberation can be succinctly described through two principles: Aanma Ozhukkam (spiritual discipline—duties or practices aimed at self-realisation) and Jeeva Ozhukkam (conduct towards fellow beings). As articulated by the Vajrayana school of Buddhism, a Siddha is one so attuned to the cosmos that they exist without restraint, as a free agent capable of manipulating cosmic forces within and beyond themselves. Achieving such harmony requires profound philosophical realisation, a state often out of reach for those caught in the turmoil of daily life.[2]

To guide the common person towards their highest potential and self-realisation, the Tamil Siddhars introduced the concepts of Naal Ozhukkam (daily disciplines) and Kaala Ozhukkam (seasonal disciplines). Recognising the physical, mental, and spiritual obstacles that hinder this journey, they also devised the Siddha system of medicine.

This integration of spiritual philosophy with practical, holistic healing is where Siddha medicine stands apart—not only from other traditional systems but also from Ayurveda. It serves as both a path to well-being and a bridge to higher consciousness, making it a unique contribution to humanity's quest for truth.

> "Churn the intestines in Suddhi practice; Your bowels become clean;
>
> Then control the breath in the heart's region
>
> And make it pervade the nadis entire;
>
> They who can do this Will gain a body; That no fire can burn".
>
> Thirumanthiram 726

In the Tamil Siddha tradition, Vaatha, Pitha, and Kapam are not merely diagnostic or therapeutic tools; they are profound instruments through which a healer facilitates the liberation of the individual. In this context, every practitioner of Siddha medicine, in their purest form, embodies the role of a Satguru, guiding and empowering the common person on their path to liberation.

Origins and Evolution of the Siddhar Tradition

The Siddhar tradition and the Tamil-speaking land have remained deeply intertwined throughout history. As a result, the origins of Siddha medicine cannot be discussed without referencing the Land of the Tamils.

The history of Tamil Nadu is rooted in the first Sangam era. The Tamil Sangams were ancient assemblies of poets, scholars, and sages that significantly influenced Tamil literature and culture. These Sangams, believed to have spanned three successive eras, were centered in Tamil Nadu and contributed to the development of classical Tamil poetry, grammar, and thought. The first Sangam is traditionally dated to 9600

BCE–5200 BCE though the first two Sangams are often regarded as legends. However, literary and archaeological evidence supports the existence of a third Sangam, possibly from 600 BCE onward, as suggested by findings like the Keeladi excavations and Sivakalai burial urns. These artefacts reveal that the Sangam era began earlier than previously thought, with iron technology dating back to 2172 BCE.[3]

The Sangam period also provides insights into the origins of medicine in Tamil culture. Maruthuvar Dhamodharanar, a poet from that era, bore the title "Maruthuvar"[4] meaning doctor. This indicates that medicine as a profession existed during the Sangam era. Similar to how biomedicine is simply referred to as "medicine" today, the prevailing medical system of that time was known as Maruthuvam. Over time, this practice evolved and became known as Siddha Maruthuvam or the medicine of the Siddhars.

The Tholkappiyam (roughly dated to the 3rd century BCE)[5] considered the earliest available literary work in Tamil, is a comprehensive treatise on grammar that also delves into the principles of life. This work introduces the concept of Arivar—a term used for realised beings—and proposes that the world is composed of five elements (Imperumboothangal): earth, fire, water, air, and space. These elements form the foundation of the Tridosha theory in Siddha medicine, as summarised in the verse:

> ***"A structured blend of earth, fire, water, air, and space"***
>
> —Tholkappiyam, Marabiyal, 1581

The Siddhar tradition likely has its origins in Sankhya philosophy, which explains the interplay between Purudan (Consciousness) and Prakruthi (Nature), manifesting as the Panchabootha Pancheekaranam (the interaction of five elements). This principle underpins the framework of Siddha medicine, particularly the 96 Tattwas. Unique in its adaptability, the Siddhar tradition incorporates elements from Sankhya philosophy as well as the Ajivaka and Saiva Siddhanta schools of thought in India, creating a holistic system of medicine and philosophy.

It is highly likely that the Siddha tradition, which may have started as a fraternity for the scientific minds of its time, evolved to address the socio-political challenges of their era. This made Siddhars place Self-improvement and not bhakthi as the tool for liberation similar to the Yogic philosophy.

The Vedanta and Siddhanta traditions are often seen as fundamentally opposing. However, Siddhar Thaayumanavar highlights the possibility of unity in his homage to Siddhas:

> O ! The Host of Siddhas of Divine powers who have attained the noblest order of viewing the Vedanta and the Siddhanta alike!
>
> Poems on Siddhar ganam,
> Siddhar Thaayumanavar

This synthesis reflects a deep understanding of both traditions, enabling the Siddhars to transcend their limitations and emphasise universal brotherly love as the true path to divinity.

Siddhars profoundly believed in the sanctity of the body as a divine temple. As stated in Thirumanthiram:

> "Time was when I despised the body;
>
> But then I saw the God within
>
> And the body, I realised, is the Lord's temple
>
> And so I began preserving it with care infinite".
>
> Thirumanthiram, poem 725

They also celebrated love as the essence of divinity

"The ignorant prate* that Love and Siva are two,

But none do know that Love alone is Siva

When men but know that Love and Siva are the same,

Love as Siva, they ever remained"

Thirumanthiram, poem 370

Thus, the idea that divine realisation lies in nurturing love and preserving the body, ultimately unlocking the divinity within, is the essence of the Siddha tradition.

Attempts to assign a specific date or time period to the Siddha tradition are futile, as the essence of a Siddha is boundless. Any scientific effort to pinpoint its origins often devolves into debates such as North versus South or Tamil versus Sanskrit. A Siddha is eternal, existing from the beginning of time and continuing beyond temporal dimensions. Rather than focusing on dating the tradition, it is more meaningful and respectful to understand its teachings and incorporate them into practice. While the antiquity of Siddha holds some significance to the common man, its true value lies in the profound knowledge it imparts.

The Four Pillars of the Siddha Tradition

Unlike the *neti neti* (not this, not that) principle of Vedanta, the Siddha tradition embraces everything as part of the self. Rather than rejecting the world and its elements, a Siddha perceives everything as it is. Remaining unattached, taking no credit, and acting solely as an instrument of the divine, a Siddha attains absolute freedom from all karma.

To better understand the Siddha tradition, it can be viewed as a synthesis of four core aspects:

1. Vaatham - Alchemy
2. Vaithiyam - Medicine
3. Gnaanam - Wisdom
4. Yogam - Yoga

However, these categories are not rigid. For example, Vaatham does not solely refer to the alchemical transformation of base metals into higher forms; it also symbolises inner alchemy—the transmutation of the self from ignorance to enlightenment. Similarly, Yogam extends beyond the union of the self with the divine; even the amalgamation of mercury with another metal can be seen as an act of Yogam.

This holistic perspective, which sees all things as different manifestations of the same essence, is fundamental to the Siddha way of life.

1. **Vaatham** - Commonly referred to as Rasavatham, alchemy is a cornerstone of the Siddha system. While alchemists worldwide sought the Philosopher's Stone to transform base metals into gold, the Siddhars held a deeper perspective. They believed the true Philosopher's Stone was the touch of an enlightened being, and real alchemy was the transformation of ignorance into enlightenment. A distinctive feature of Siddha alchemy is that every herbo-mineral formulation in Siddha medicine embodies a miniature representation of this profound alchemical process.

2. **Vaithiyam:** The most well-known branch of the Siddha tradition is Siddha medicine. Originally designed to liberate a Sadhaka of the Siddha tradition from the limitations that bind them—such as diseases of the physical, mental, and spiritual bodies—this

practice has now extended its reach to a broader audience under the banner of Siddha medicine.

"One that cures physical ailment is medicine,

One that cures psychological ailment is medicine,

One that prevents ailment is medicine,

One that bestows immortality is medicine"

- Siddha Thirumoolar

This profound definition by Thirumoolar sets Siddha medicine apart from all other medical systems. The Siddha approach to health encompasses a holistic perspective achieved through 32 types of internal medicines, 32 types of external medicines, Varmam, and Thokkanam techniques. While a detailed explanation of each internal and external medicine type is beyond the scope of this work, it is worth noting that many of these dosage forms are unique to the Siddha tradition. In fact, this very classification of medicines is entirely absent in Ayurveda.

While a Siddha's understanding perceives the body as an integrated whole, for contemporary purposes, the following can be regarded as the primary branches of Siddha medicine:

- Siddha Pharmacology (Gunapatam),
- Siddha Toxicology (Nanju Maruttuvam),
- Siddha Pathology (Noinadal),
- General Medicine (Maruttuvam),
- Obstetrics and Gynaecology (Sool maruthuvam, Makalir Maruttuvam),
- Siddha Paediatrics (Kulantai Maruttavam),
- Surgery (Aruvai Maruttuvam),
- Dermatology (Tol Maruttuvam),
- Ear Nose Throat (Katu, Mukku, Tondai Maruttuvam),
- Ophthalmology (Kan Maruttuvam),
- Psychiatry (Kirikai noi Maruttuvam),
- Pressure Manipulation Therapy (Varmam),
- External Therapy (Pura Maruttuvam),
- Geriatrics (Mutiyur Maruttuvam),
- Yogam and Rejuvenation (Kaayakarpam),
- Preventive and Social medicine, and
- Palliative care.

Among these branches, Gunapaadam, Noi Nadal and Varmam are considered the most fundamental and warrant special recognition.

a. Gunapaadam - Gunapaadam, also known as 'Porut Panbu,' is the comprehensive compilation of knowledge concerning substances used for healing and consumption. This field encompasses a deep understanding of materials derived from animal, mineral, and plant sources. It covers a wide array of topics, including the origins, synonyms, identification, collection, and characterisation of these substances. Additionally, Gunapaadam delves into their therapeutic properties, formulations, purification processes (Suddhi), therapeutic uses, dosage forms, potential applications, contraindications, anti-dotes and more.

   Gunapaadam encompasses a vast repository of knowledge, covering

over 600 herbs, 11 metals, 64 Paadanangal (loosely translated as poisonous substances), 120 Uparasam (accessory minerals), and 25 Kaarasaram (various chemical salts). Such an extensive collection of medicinal substances with their intricate details and unique formulations is unparalleled in any other medical system, both historically and in the present day. The chemistry of Siddha medicine is so comprehensive that it warrants an entire discussion of its own. Additionally, the synthetic preparation methods (Vaippu) in Siddha are unique. For instance, Siddha texts detail the synthesis of substances such as cinnabar, asafoetida, camphor, and pearls.

b. Noi naadal - Siddha Pathology and diagnostics:

"Disease, its cause, what may abate the ill:
Let leech examine these, then use his skill".

- Kural 948

"Is there a purpose, one could decree,
For medicine, but to cure malady?"

- Siddhar Theraiyar, Theraiyar Maruthuva Bharatham.

Despite their vast knowledge of therapeutics, and unlike other medical systems of the time that attributed diseases to divine causes, the Siddhars emphasised the importance of diagnosing the disease first. They strongly believed that effective treatment required a deep understanding of the interplay between the patient, the illness, the season, and the prescribed remedy.

"The habitudes of patient and disease, the crises of the ill

These must the learned leech think over well, then use his skill".

Thirukkural

The Tamil Siddhars, skilled in the art of diagnosis, developed the Eight-Fold Diagnostic System known as Envagai Thervu, which includes the inspection, palpation, and examination of various physical and physiological indicators: Naadi, Sparisam, Tongue, Colour, Language, Eye, Urine, and Feces.

- ***Naadi:*** A key feature of Siddha diagnosis, the Naadi involves not just identifying the possible diagnosis but also assessing the status of each organ, Dhaathu (body tissue), chakra, and the Dhasa Naadi (explained later)
- ***Sparisam:*** This refers to the examination of the patient through palpation.
- ***Naa:*** Many traditions view the gut as the origin of all diseases, with the tongue acting as a mirror to the gut. In Siddha tradition, examining the tongue provides valuable insights into the patient's health.
- ***Niram:*** This involves examining the natural color of the body and its external organs.
- ***Mozhi:*** This includes evaluating the patient's spoken language, cognition, and voice.
- ***Vizhi:*** The examination of the eyes and visual inspection by the physician.
- ***Moothiram (Neerkuri)*****:** Urine examination involves analysing its smell, colour, specific gravity, froth, and precipitates.
- ***Urine (Neikuri)*****:** Neikuri assessment involves observing the pattern that is elicited on the surface of the urine, when a drop of oil is added to the urine. Based on the pattern that emerges, the Tamil Siddhars classified the diseases into Saathiyam (curable), Yaapiyam (manageable but not curable),

Asaathiyam (Diseases that require palliation).

- ***Malam:*** This refers to the examination of excreta, including feces and other bodily discharges.
- ***Varmam*** - A unique facet of the Siddha tradition.

  Varmam refers to specific points on the body where pranic (life) energy is concentrated. When these points are struck forcefully, they can cause varying effects on the body, depending on the force applied, the timing, duration, and the physical condition of the individual. Conversely, when these points are manipulated therapeutically, they can produce curative effects for various ailments.

  The Varmam points are situated along channels called Naadi, which serve as pathways for the activities of bodily elements like Dosha (Vata, Pitta, Kapha), Dhathu (the 7 basic building blocks), Mala (waste), Agni (digestive fire), and others. There are said to be 72,000 Naadis, of which 108 are significant and 10 are considered vital.

  In practice, the focus is on 12 Padu Varmam points, each connected to 8 Thodu Varmam points, bringing the total number of Varmam points to 108.

  Although Varmam is an integral part of Siddha medicine, it has the potential to function as a standalone system of healing. It is widely practiced as such in southern Tamil Nadu and in regions of Kerala bordering Tamil Nadu.

3. Yoga of Siddhars

"Yama and Niyama, countless are their virtues.

Pranayama flows with grace and discipline.

Dharana, Dhyana, and Samadhi bring stillness profound

These together form the noble Eightfold Path".

Thirumanthiram poem 552.

The Attanga Yoga (Eightfold Path) of the Siddhars is a comprehensive spiritual framework designed to harmonise the body, mind, and soul, leading to enlightenment. Rooted in ancient wisdom, it emphasises disciplined practices for self-realisation and liberation. The eight stages are:

1. ***Theethu agattral or Iyamam*:** Ethical restraints or universal moral principles, such as non-violence and truthfulness.
2. ***Nandru aatral or Niyamam*:** Personal disciplines like cleanliness, contentment, and self-study.
3. ***Irukkai or Aasanam*:** Physical postures that prepare the body for meditation and promote health.
4. ***Vali nilai or Pranayamam***: Breath control techniques to regulate Prana
5. ***Thogai nilai or Prathiyakaaram*:** Withdrawal of the senses to focus inward and detach from external distractions.
6. ***Porai nilai or Dhaaranai*:** Concentration or focused attention on a single point or object.
7. ***Ninaiththal or Thiyanam*:** Deep meditation for unbroken awareness of the divine.
8. ***Nosippu or Samaadhi*:** The ultimate state of spiritual absorption and union with the universal consciousness.

The Siddhars viewed Attanga Yogam as a holistic path, not only for spiritual growth but also for physical and mental well-being, making it an essential part of their teachings.

4. Gnaanam - The Wisdom of Tamil Siddha

As the late legendary Dr. L. Mahadevan aptly observed, learning occurs at three levels: Knowing, Understanding, and Realising—or Becoming. The Tamil Siddha tradition placed the highest value on the ultimate stage of Realising or Being. This principle is beautifully encapsulated in the words of Siddhar Sattaimuni:

> "Whatever is in the Macrocosm is in the Microcosm,
> Whatever is in the Microcosm is in the Macrocosm.
> The Macrocosm and Microcosm are one and the same
> When you look at it with the right perspective!"
>
> — Sattaimuni Gnaanam

By knowing, understanding, and ultimately realising that they are one with the cosmos, the Siddhars transcended individuality to become the cosmos itself. This profound philosophy—seeing everything and everyone as facets of the same universal entity—requires not just intellectual comprehension but an experiential realisation, a feat far easier said than achieved.

Although the Siddhars often sang about Bhakti (devotion), they emphasised the importance of individual effort. As Thirukkural 619 states:

> "Though fate divine should make your labour vain, Effort its labour's sure reward will gain."

This core tenet of the Siddha tradition values self-effort above all while simultaneously advocating for detachment from the fruits of one's actions—whether positive or negative. By doing so, one liberates oneself from karma and progresses toward a state where the distinctions of doer, deed, and action dissolve. In this ultimate state, one ceases to act as an individual and instead becomes the act itself.

What is shared here as the wisdom of the Tamil Siddha tradition is merely a drop in the vast ocean of their knowledge. The profound teachings of the Siddhars can only be truly grasped through experiential learning under the guidance of a Guru.

Evolution of Siddha Medical Education, Research, and Governance in India[6]

The formalisation of Siddha medical education and governance marked significant milestones over the course of nearly a century. The traditional Gurukulam-based system of learning gradually evolved into modern institutional frameworks.

1925: The Government School of Indian Medicine was established in Madras, offering education in Siddha, Ayurveda, and Unani, marking the institutionalisation of Siddha medical training.

1926: The Government Hospital of Indian Medicine was inaugurated and attached to the school to provide clinical training and healthcare services.

1940: The Sir Mohammed Usman Committee was formed to develop Indian systems of medicine in Tamil Nadu.

1944: The establishment of the Indian Medical Practitioners Co-operative Pharmacy and Stores (IMPCOPS) in Madras facilitated the manufacturing and standardisation of Siddha medicines.

1947: The school was renamed the College of Indian Medicine, offering the Graduate of College of Indigenous Medicine (G.C.I.M) degree.

1955: The institution became the College of Integrated Medicine, integrating Indian and Western medicine, with graduates governed by the Integrated Medical Practitioners Act of 1956.

1960: The Gujarat Ayurved University in Jamnagar initiated research in Siddha medicine.

1964-1966: A five-year Siddha degree course (B.I.M.) commenced at the Government College of Indian Systems of Medicine in Palayamkottai, initially affiliated with the University of Madras, later transitioning to Madurai Kamaraj University in 1966.

1969: The Central Council for Research in Indian Medicine and Homeopathy (CCRIM&H) was established to coordinate research in Indian medicine.

1970: The Directorate of Indian Medicine and Homoeopathy was created by the Tamil Nadu government.

1971:

- The Central Council of Indian Medicine (CCIM) was constituted under the IMCC Act of 1970.
- The Central Research Institute for Siddha was established in Chennai for scientific research.
- The Indian Institute of History of Medicine (IHM) in Hyderabad began historical research on Indian medicine.

1975: The Siddha Pharmacopoeia Committee (SPC) was constituted to standardise Siddha medicines.

1977: The BIM degree was renamed Bachelor of Siddha Medicine and Surgery (B.S.M.S) following the enforcement of the IMCC Act.

1978: The Central Council for Research in Ayurveda and Siddha (CCRAS) was formed.

1985: The second Siddha Medical College was opened in Pazhani for the B.S.M.S degree, later relocated to Chennai in 1993.

1995:

- A dedicated department for Indian Systems of Medicine and Homoeopathy was created by the Government of India, later renamed Department of Ayush in 2003.

1999: The National Institute of Siddha (NIS) was established in Chennai under the Department of Ayush and formally inaugurated in 2005 by Prime Minister Dr. Manmohan Singh.

2001: The Traditional Knowledge Digital Library (TKDL) project was initiated to document traditional medical knowledge.

2004: The Siddha Medicinal Plants Garden was set up at Mettur Dam under CCRAS.

2010: The Central Council for Research in Siddha (CCRS) was established by bifurcating CCRAS.

2014: The Ministry of Ayush was created, upgrading the Department of Ayush into a full-fledged ministry.

2017: A Siddha (Varmam) Unit was launched under the ITEC Programme in Sungai Buloh Hospital, near Kuala Lumpur, Malaysia.

The Relevance of Siddha Medicine

The disease is both the cause and effect of alterations that rise in Udal Thaathu (7 basic building blocks) and Uyir thaathu (Vaatha, Piththa, Kapam) resulting from the variations in bodily deeds, beginning with food. Siddha Maruthuva Noi nadal

- **Preventive Medicine (Pini Anuka Vithi Ozhukkam - PAVO):** A distinctive feature of Siddha medicine is its emphasis on preventive and social aspects of health. The detailed guidelines in PAVO focus on disease prevention and maintaining overall well-being. Adhering to PAVO principles can significantly reduce India's "triple burden of diseases"—the unfinished agenda of communicable diseases, non-communicable diseases (NCDs), and emerging infectious diseases.
- **Syndrome-Specific Medicine:** Siddha medicine excels in managing syndromes, with single formulations effectively addressing a combination of symptoms. This syndrome-specific approach reduces the need for multiple medications, thereby minimising side effects and lowering healthcare costs. A striking example is the simple polyherbal Siddha formulation Kabasura Kudineer (KSK), which proved effective in managing the multi-system inflammatory complications of COVID-19.[7] Notably, medicines in the Kudineer category are considered foundational among Siddha formulations. The success of a basic polyherbal preparation like KSK in saving countless lives during a global healthcare crisis highlights the immense, yet untapped, potential of Siddha herbo-mineral formulations.
- **Precision Medicine:** With unique diagnostic tools like Dhega Ilakkanam and En Vagai Thervu, Siddha medicine provides personalised treatment tailored to individual needs. Integrating these principles with modern concepts of systems health could usher in a new era of precision medicine.
- **Gut-Driven Health:** Modern science increasingly recognises the importance of gut health, a concept long central to Siddha medicine. According to Siddha teachings, many illnesses originate in the gut. Traditional treatment protocols emphasise diet and lifestyle modifications alongside herbal and herbo-mineral formulations. These treatments support gut health by protecting the intestinal barrier, reducing inflammation, balancing gut bacteria, and enhancing the bioavailability and activity of herbal compounds, while minimising toxicity.

Siddha Medicine Today: Recent Initiatives in Research and Standardisation

Siddha medicine is a well-established form of traditional and complementary medicine, acknowledged by several Member States. The creation of the WHO International Standard Terminologies on Siddha Medicine is a vital step toward ensuring the delivery of safe and effective Siddha-based health services. This document encompasses a total of 2,643 Siddha medicine terms (3,697, including synonyms).[8]

Additionally, the development of Standard Siddha Treatment Guidelines for 30 selected diseases provides a comprehensive framework detailing etiology, treatment protocols, differential diagnoses, dietary recommendations, and rejuvenation therapies. This initiative represents a collaborative effort by the National Institute of Siddha (NIS) and the WHO Country Office for India, New Delhi.[9]

Several R&D efforts have established the validity and evidence base that is increasingly being demanded for traditional medicine systems in major markets globally. A few examples are mentioned below.

- Several randomised controlled trials (RCTs) on the polyherbal Siddha formulation Kabasura Kudineer and other Siddha medicines demonstrated their efficacy in alleviating symptoms associated with COVID-19. [10, 11, 12, 13, 14, 15]

- Public health initiative (PHI) studies, on the use of a combination of Siddha drugs to reduce anemia among adolescent girls have highlighted the significance of integrating the Siddha system on addressing anemia.[16]
- Research on various Siddha practices, including Siddha fasting, Varmam, and Thokkanam, has also shown their effectiveness.[17, 18, 19]
- A study conducted at the Maternity Care Centre of Poonamallee (January 2017–June 2018) found that the utilisation of the Amma Magaperu Sanjeevi Kit alongside fortified supplements significantly improved haemoglobin levels in pregnant women.[20]

Conclusion

Tamil Siddha medicine is often dismissed as merely a Tamil version of Ayurveda, an assertion that appears unfounded upon closer examination of its principles and practices. The claim stems primarily from the presence of Sanskrit or Sanskritised terminology in Siddha texts. However, this linguistic overlap likely reflects historical factors, such as the Siddhars' practice of writing in multiple regional languages to disseminate their sacred knowledge widely. Additionally, the socio-political interactions, cultural exchanges, and mutual respect between northern and southern India in ancient times may have contributed to Sanskrit serving as the scientific lingua franca of the era.

Critics often cite the colloquial nature of Siddhars' poems. However, the Siddhars intentionally used colloquial language and musical styles to make their teachings accessible to a broader audience. These poems, often transmitted as folk songs, helped preserve and propagate Siddha knowledge across generations. At the same time, many Siddhars also composed works in classical Tamil, such as Theraiyar Venba, demonstrating the system's intellectual depth.

Acknowledging the uniqueness and relevance of Siddha medicine can ensure the preservation and advancement of this remarkable tradition for future generations. Its potential spans preventive, promotive, curative, palliative, and rehabilitative healthcare services, with a strong emphasis on maintaining quality within the public health sector.

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Homoeopathy Sector in India – An Overview

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Abstract: Homoeopathy, a medical system founded on the principle of "like cures like," has evolved into a globally recognised healthcare practice. In India, its integration into the healthcare system has been propelled by public trust, government support, and extensive research initiatives. With over 300,000 practitioners and significant infrastructure, Homoeopathy plays a pivotal role in addressing chronic and lifestyle diseases. The Indian market for Homoeopathic products has shown substantial growth, driven by quality manufacturing, regulatory standards, and international collaborations. Ongoing advancements in research, education, and global outreach position India as a leader in Homoeopathy, underscoring its potential in holistic and integrative healthcare.

Keywords: Homeopathy, Ayush, Health

Introduction

Homoeopathy, a medical system founded in 1796 by German physician Dr. Samuel Hahnemann, operates on the principle of "like cures like" (Patil & Gandhi, 2024). This means that substances causing certain symptoms in a healthy person can treat similar symptoms in an unwell person. For example, caffeine, which can cause sleeplessness, might be used in diluted form to treat insomnia. Homoeopathy views health as a balance of mind and body, and treatments aim to gently restore this harmony by stimulating the body's natural defences. Homoeopathic medicines direct and stimulate the body's self-regulatory mechanisms to restore its natural equilibrium. The treatment is customised individually with the objective of curing the patient while addressing the underlying cause of the disease comprehensively and meticulously. It can be used safely by pregnant women, lactating mothers, infants, children, the geriatric population, etc., for the treatment of various diseases. Medicines are palatable and easy to administer, and the treatment is comparatively more cost-effective than other medical systems.

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According to a survey conducted in India, 62 per cent of current Homoeopathy users have never tried conventional medicines for day-to-day health problems, and 82 per cent would not switch to conventional treatments unless it is an emergency.[1] There may be several reasons for this trust. Treatment with homoeopathic medicines is safe, effective and based on natural substances. With the use of single simple substances in micro-doses, medicines are not associated with any toxicological effect and can be safely used for pregnant women and lactating mothers, infants and children and in the geriatric population. Medicines, instead of having a direct action on the microorganisms, act on the human system (self-protective) to fight disease processes. As such, no microbial resistance is known to develop against homoeopathic drugs. The mode of administration of medicines is easy. There are no invasive methods, and medicines are highly palatable, enhancing their acceptability. Lack of diagnosis is not a hindrance to initiating treatment with homoeopathic medicines. Individualised approach to treatment is in consonance with an increasing need for customised treatment, which is being realised in the modern era. Homoeopathic remedies are not addictive- once relief occurs, the patient can easily stop taking them. Treatment is comparatively more cost-effective than other therapeutic systems.

Global Scenario

Homoeopathy is now practised in over 80 countries and is officially recognised in 42.[2] In India, it's considered an integral part of the healthcare system, often existing alongside conventional (allopathic) medicine (Rossi *et al*. 2015). Three out of four Europeans know about Homoeopathy, and of these, 29 percent use it for their own health care.[3] Studies have identified Homoeopathy to be the most frequently used CAM therapy for children in European countries (Sarsina & Iseppato, 2011). The National Health Interview Survey 2007 (of the past 12 months) estimated that 3.9 million adults and 910,000 children used Homoeopathy in North America (Barnes *et al*., 2008). Many studies have shown that people across Europe and North America increasingly turn to Homoeopathy for their healthcare needs, particularly for children's ailments (Viksveen & Steinsbekk, 2005; Spigelblat *et al*. 1994).

It is officially recognised in Central and South American countries (Brazil, Chile, Colombia, Costa Rica, Cuba, Ecuador, Mexico), European countries (Belgium, Bulgaria, Germany, Hungary, Lithuania, Portugal, Romania, Russia, Spain, United Kingdom) and in Asia (India, Nepal, Pakistan, Sri Lanka, Bangladesh)(5). It is integrated into mainstream healthcare in Brazil, India, Pakistan, Sri Lanka, Mexico, Bangladesh and the United Kingdom.

Homoeopathy's Rise in India

Homoeopathy arrived in India in the early 19th century (1839), and German missionaries practised it along the coasts of Bengal (Das, 2015). A key figure in its introduction was Dr. John Honigberger, who famously treated the Maharaja Ranjit Singh of Punjab. Its early success in treating epidemics like cholera helped establish Homoeopathy as a trusted form of medicine among the Indian population.

The integration of Homoeopathy into Indian healthcare systems expanded over the decades, driven by public trust and

sustained government support, resulting in its widespread acceptance as a mainstream practice. More than 3,00,000 registered practitioners are providing health care services through public and private sectors in both rural and urban areas.[4] Homoeopathic services are provided to the people through government, private and voluntary healthcare organisations.

Homeopathy Industry in India

Globally, Homeopathy product market is expected to reach USD 10.47 billion in 2024 and grow at a CAGR of 12.02 per cent to reach USD 18.48 billion by 2029.[5] The market for Homoeopathy products in the Asia-Pacific region is anticipated to be substantial, attributed to the high number of qualified practitioners, government support, and strong public demand, particularly for managing chronic and lifestyle-related disorders. Dilution segment is expected to hold a significant market share over the forecast period.

The homoeopathy product market is moderately fragmented due to many industries operating globally and regionally. The competitive landscape includes an analysis of a few international and local companies with major or significant market shares. Some global leaders in the Homoeopathic manufacturing sector are Willmar Schwabe, Boiron, AinsworthsLtd, BiologischeHeilmittel, Heel GmbH, Hevert - Arzneimittel GmbH & Co. KG, A Nelson & Co Ltd.

In India, there are 339 licensed and GMP-certified Homoeopathy drug manufacturers.[6] At the National level, SBL, Baksons, WSI, HAPCO, HOMCO, Bhargava Phyotochemicals, Hahnemann Laboratories, Medisynth, and B Jain Pharmaceuticals are major manufacturers. As per MRFR analysis, the India Homeopathy Product market size was estimated at 4.46 (USD billion) in 2022. The India Homeopathy Product market is expected to grow from 5.12 (USD billion) in 2023 to 24.87 (USD billion) by 2032.[7] The India Homeopathy Product market CAGR (growth rate) is expected to be around 19.62 per cent during the forecast period (2024–2032).

Quality Control of Medicinal Products and Manufacturing Sector

The Drugs and Cosmetics Act, 1940, Rules, 1945 have specific provisions for homoeopathic drugs; monographs on more than 1000 drugs have been published in the Homoeopathic Pharmacopoeia of India, which gives the identification features and standardisation parameters for the preparation of Homoeopathic drugs. The drug manufacturing industry has to be GMP compliant. Drug research studies involving drug standardisation, drug proving and clinical verification generate standardisation parameters for the preparation of Homoeopathic drugs. Drug research studies involving drug standardisation, drug proving, and clinical verification generate standardisation parameters for drug substances and the therapeutic indications of drugs.

Survey, Collection and Cultivation of Medicinal Plants

Survey of Medicinal Plants and Collection Unit (SMPCU) of CCRH, established in 1979, is located at Emerald, Nilgiri District, Tamil Nadu. It conducts surveys, collection and cultivation of medicinal plants used in Homoeopathy and supplies

raw drug samples to the Central Research Institute Homoepathy, Noida and Drug Standardisation Unit of Homoeopathy, Hyderabad, for standardisation studies. The Unit also cultivates exotic and indigenous medicinal plants used in Homoeopathy and maintains the garden, which is spread over 12.7 acres of land[8](10).

Government Support and Development in India

India's Ministry of Ayush has played a vital role in promoting Homoeopathy through dedicated programs, funding, and research support. Government backing ensures that Homoeopathy in India is continually advancing, with a strong focus on evidence-based practice, quality manufacturing standards, and modern educational frameworks. The government of India established institutes and organisations in the areas of education and research and laid down standards for quality manufacturing.

Homoeopathy in Practice

Homoeopathic clinics, both private and government-run, are available across India in urban and rural areas, ensuring accessibility. Homoeopathy offers remedies for a wide range of conditions, including allergies, digestive issues, stress, joint pain, and skin conditions like eczema. Research-backed studies show positive effects on conditions like skin diseases, rheumatoid arthritis and diabetes, where conventional treatments sometimes fall short. Symptomatic management in an integrative manner with conventional medicine of Covid 19 and with further support through evidence-based studies brought much confidence among the practitioners of Homoeopathy and thereby helped patients. Patients appreciate the individualised nature of Homoeopathy, where each treatment plan is tailored to the patient's symptoms and constitution, not just the disease.

Table 1: Statutory and Autonomous Bodies Under Ministry of Ayush, Government of India

National Commission for Homoeopathy[9]	Central Council for Research in Homoeopathy[10]	Pharmacopoeia Commission for Indian Medicine & Homoeopathy[11]	National Institute of Homoeopathy[12]
Regulatory authority for education and practice in India.	Apex body to conduct and monitor research activities.	Lays down standards of Homoeopathic drugs, their verification and for testing the purity and quality.	Model institute for medical education and research.
Established in 2021 as a statutory body under NCH Act, 2020	Established in 1978 as an autonomous body managed by a governing body headed by the Minister of Ayush	Established in 2010 as an autonomous body under the Minister of Ayush and was registered under Societies registration Act	Established in 1975 as an autonomous organisation managed by a governing body headed by the Minister of Ayush

Source: Authors own compilation.

Education of Homoeopathy in India

Education in Homoeopathy is being regulated by the National Commission for Homoeopathy. The Commission has developed course curriculums for various courses. In the field of Homoeopathy education, there is a graduate degree course of BHMS (Bachelor of Homoeopathic Medicine and Surgery of 5 1/2 year duration including one-year internship) and is being imparted by more than 270 Homoeopathic medical colleges in most of the States in India. A separate course, Doctor of Medicine in Homoeopathy [MD (Hom.)], of 3 years duration is conducted in various recognised specialities for developing expertise in the respective fields by 70 institutions (11). There are more than 20,000 and 1900 seats for UG and PG courses, respectively, in India. Bringing super speciality courses is in the pipeline.

Health Care Coverage

Ayush services are included in the country's health care delivery system at all levels, including primary, secondary, and tertiary health care. The Government of India has a number of programmes and initiatives for the promotion of Ayush systems and an increase in health care coverage in the country. The regulations ensure that quality of care is maintained and medical pluralism permits patients to opt for treatment of their choice.

Healthcare services in Homoeopathy are provided by 253 hospitals and 8593 dispensaries run by state governments and municipal bodies, the Central Government Health Scheme, the Labour Ministry and the Railway Ministry.[13] The Government of India launched the National Rural Health Mission (NRHM) to carry out the NRHM and mainstream the Indian system of medicine and Homoeopathy to facilitate health care through these systems. Under NRHM, AYUHS facilities have been co-located in 416 district hospitals, 2942 community health centres and 9559 primary health centres in 2011.[14] 'Ayush Wellness Centre' was inaugurated by the Hon'ble President of India at the President's Estate, New Delhi.

India's Global Role in Homoeopathy

India is consolidating its efforts to integrate homoeopathy through the wide range of experiences gained to become a global destination for homoeopathic education, practice, research, and drug development.

India has become a leader in Homoeopathic education and research, with international collaborations in countries like Sri Lanka, Mexico, and more. India has signed a Letter of Intent with Mexico to share expertise in traditional medicine and Homoeopathy.[15] India's homoeopathic colleges attract students worldwide, and Indian-manufactured homoeopathic medicines are exported globally. Students from different countries, including Germany, BIMSTEC countries, SAARC countries, etc., have been coming to India to study Homoeopathy. India's expertise in Homoeopathy serves as a model for other countries seeking affordable, resource-efficient health solutions, particularly in developing nations.

Research and Development of Homoeopathy

The Central Council for Research in Homoeopathy (CCRH), fully funded by Central Govt. in India, coordinates research across 32 institutes, contributed to more than 170 clinical conditions like HIV/AIDS, Gastroenteritis, Chronic Sinusitis, Influenza-like illness, Benign prostatic hyperplasia, acute haemorrhoids, cervical spondylosis pain management, urolithiasis, Acute Rhinitis in children, Acute encephalitis syndrome, Covid-19, Acute otitis media, hypertension, thrombocytopenia due to dengue.[16] The Ministry also funds research grants for academics and scientists to explore new uses of Homoeopathy under an extra-mural research scheme. Many new clinical research studies are being undertaken which explore the effectiveness of Homoeopathy in specific disease conditions, including modern-day diseases like internet gaming disorder. A large number of observational clinical research studies have also been conducted, and a number of randomised control trials are in progress. Basic research in the field of Homoeopathy has been conducted on biological models (in-vivo and in-vitro) and on physico-chemical models. More than 100 new Homoeopathic medicines, mainly of Indian origin, are introduced for their therapeutic use after drug proving and clinical validation(16).[17]

Homoeopathy as a science evolved from a foundation of theoretical concepts. Scientists today have taken up the challenge to work on and establish these theoretical constructs on scientific lines. Safety and efficacy studies are an important component of research in Homoeopathy. Evidence level of Homoeopathy, generated in several conditions, is sufficient to ground its use in the scientific framework of general medical practice. The current scientific advancement has made many studies possible. Research, however, is a complex area and requires the interaction of knowledge of Homoeopathy with an in-depth understanding of medicine, biotechnology, physics, chemistry, nanotechnology and social sciences.

Around the world, research is often funded by the government, universities, industries and non-profit foundations. Public funding has been noted in the United States (US), Denmark, Germany, Italy, Norway, the UK and India. In the US, the National Centre for Complementary and Alternative Medicine is one of the 27 institutes and centres that make up the National Institutes of Health within the US Department of Health and Human Services, and also supports research in Homoeopathy. The Karl und Veronica Carstens-Stiftung is the largest foundation in Europe to fund research in complementary and alternative medicine (human and veterinary), including Homoeopathy.

Research outcomes are published in various acclaimed journals and the study details and outcomes are available in the databases like Pubmed, HomBRex, British Homoeopathic Library, Homoeopathic Research Institute, European Committee for Homoeopathy, LMHI and Ayush Research Portal. Homoeopathy (erstwhile British Journal of Homoeopathy) of the Faculty of Homoeopathy, UK, is an international peer-reviewed indexed journal aimed at improving the understanding and clinical practice of Homoeopathy by publishing high-quality articles on clinical and basic

research, clinical audit, evidence-based practice of Homoeopathy and is presently running in its 101 years.[18] American Journal of Homoeopathic Medicine by the American Institute of Homoeopathy has also completed 105 years of publication and is a peer-reviewed scientific journal specifically intended to meet the needs of physicians involved in the speciality of Homoeopathy.[19] The research studies have also been published in various journals of alternative and complementary medicine, many of which have been published in the last 20 years, e.g., the Journal of Evidence-Based Complementary and Alternative Medicine,[20] the Journal of Alternative and Complementary Medicine,[21] Focus on Alternative and Complementary Medicine,[22] Complementary Therapies in Medicine.[23]

Research in Homoeopathy needs to meet the same requirement of research evidence as that of modern medicine, and at the same time necessitates consideration of the unique philosophy of the system. Efforts are made to address key issues of concern for research in Homoeopathy through international consensus and debates. The European Committee of Homeopathy has laid down guidelines for drug proving, data collection and clinical verification and has published a multi-lingual thesaurus to bring consensus amongst researchers in these areas. Reporting Data on Homoeopathic Treatments (RedHot): A Supplement to CONSORT identifies consensus guidelines for reporting homoeopathic methods and treatments, which have been recommended for adoption by authors and journals when reporting trials of Homoeopathy.

The Indian Journal of Research in Homoeopathy is an indexed, free, open access, online, peer-reviewed journal published by the Council, which is dedicated to research studies and evidence-based case studies. The Ministry of Ayush also provides funds as grant-in-aid under an extra-mural research scheme to organisations and scientists to conduct specific time-bound research projects in the field of Homoeopathy.

The Future of Homoeopathy: Prospects and Challenges

India envisions a pluralistic healthcare model where Homoeopathy and other traditional systems coexist with modern medicine. This integration allows for a more holistic approach to healthcare, giving patients the freedom to choose the treatment that best suits their needs. With continued investment in research and education, India is working toward becoming a global destination for Homoeopathic practice and innovation. The future of healthcare could involve a balanced approach where multiple medical systems work together, with Homoeopathy playing a vital role in preventive and long-term care.

'Implausibility' from a scientific standpoint is often cited as a reason for scepticism about Homoeopathy due to ultra-high dilutions in Homoeopathy medicines. This is being addressed by many scientists who are contributing to decipher the phenomenon, majorly addressing the potentisation and mechanistic aspect of the physicochemical nature of Homoeopathic medicine. A lot has been done to demonstrate the biological effect of Homoeopathic medicines through in-vitro and in-vivo studies and further substantiated with RCTs in clinical studies with adequate controls and comparable groups. While there is a growing interest

in integrative healthcare, the integration of homoeopathy into mainstream medical practices faces resistance and requires collaborative efforts between conventional and homoeopathic practitioners. Ensuring the quality and standardisation of homoeopathic products is a challenge, keeping in view the diversity in different Pharmacopeia worldwide, which has also made an impact on exports from India. Harmony in individual drug monographs across these recognised Pharmacopeia of different countries can pave the way to enhance market sales with trade among them.

The Way Forward

Homoeopathy's success in India highlights the benefits of blending tradition with modern healthcare and supporting it through evidence-based research. With strong government support, educational excellence, and advanced research, India is leading the way in making Homoeopathy accessible and respected worldwide. Whether you're a long-time advocate or new to Homoeopathy, its growing role in healthcare invites us all to consider its gentle, effective approach to well-being. Furthermore, the growing awareness regarding the benefits of homoeopathy medicine, the adoption of key strategies by key players for promoting the usage of homoeopathy medicines, and active promotions regarding it are propelling the market growth. End with a call-to-action, inviting readers to explore more about Homoeopathy, perhaps through local practitioners or further reading, emphasising the accessible, safe, and holistic benefits Homoeopathy offers.

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Medicinal Plants Sector in India: Ensuring Active Therapeutic Properties of Cultivated Species

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Abstract : The traditional knowledge of the use of Medicinal and Aromatic Plants (MAP) for human health has been part of folklore and traditional medicine systems in India as much as on many continents. The plethora of biodiversity in all these continents has supported human wellness management over centuries. Modern living has impacted wellness management through several communicable and non-communicable ailments due to various reasons. The therapeutic effect of phytochemical-based medicines in traditional medicine systems has been perceived as a useful support to modern concepts on traditional and complementary medicine systems. The large demand for medicinal flora in those countries where their extensive use is in vogue is met primarily by natural biodiversity. The economic viability of medicinal plants offers tremendous opportunities for crop diversification and income generation to small and marginal farmers. The question of the quality and quantity of active phytochemical medicinal principles in the MAPs that are harvested from the wild and harvested from crop farms is analysed to look for their equivalence in the concentration required in traditional medicines. Conservation ethics of wild MAPs can be introduced jointly by the consumer industry and trading systems along with the National Medicinal Plant Board (NMPB) and State Biodiversity Boards (SBBs) for appropriate skilling the community who collect and supply from forests and other natural habitats. Farming practices of MAPs are suggested to simulate wild growing conditions of MAPs to secure their medicinal value.
Keywords: medicinal and aromatic plants, biodiversity, phytochemicals, traditional medicine system

Introduction

Medicinal and Aromatic Plants (MAPs) have been an integral part of human healthcare since time immemorial in most parts of the world. More than one-tenth of plant species in the globe, nearly 50000 species, are used in drugs and health products. Traditional knowledge of medicines from natural resources has sustained human health and wellness in ancient civilizations around the globe. Phytochemicals from medicinally important biodiverse flora can protect human and animal bodies from ailments. Human

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and livestock wellness can be achieved through the Traditional Medicine (TM) system, which is recognised as one of the wellness-care plans on various continents.[1]

China and India lead the world in the number of medicinal plants used, with 10608 and 7,500 species, respectively (Chie et al, 2017; Shakya, 2016), followed by Colombia, South Africa, and the United States. India has the unique distinction of possessing a substantial bio-diversity of medicinal plants, knowledge associated with their use and a good infrastructure. Indian systems of medicine (ISM) such as Ayurveda, Siddha, Unani and Homoeopathy, and therapies such as Yoga and Naturopathy were largely dependent on various MAPs for preparing traditional medicines. Herbal medicines, as used in Ayurveda (science of life), Sidha, Unani and Sow Rigpa (Tibetan systems) of health care, aim to restore balance to the body and bring harmony to the individual. Charaka Samhita, Ashtanga Hridaya, Sushruta Samhita and such ancient traditional medicine scriptures (Steven, 2003; Kutumbian, 2005; Ray et al., 1980; Meulenbeld, 1999; Sharma, 1992) are the foundational text in Ayurveda which has intense deliberation on the various facets of the medicinal function of phytochemicals available in nature.[2] In addition to serving as a primary source of raw materials for the traditional medicine system, this sector also contributes to livelihood security and generates employment opportunities for the Indian population (Lumar et al, 2015). The rich traditional knowledge and understanding-based practice by healers in our country became the basis for utilising identified plant species for various medicinal purposes.

Advancements in science have fortified traditional and complementary medicine systems, emphasising their role in holistic wellness. WHO's global report and monograph on medicinal plants highlight the regulatory frameworks, integrative medicine potential, and pharmacological benefits of phytochemicals, driving global recognition and commerce in indigenous medicine systems. The Foundation for Revitalisation of Local Health Traditions (FRLHT), Bengaluru, with the support of the National Medicinal Plant Board, has painstakingly compiled the number of botanical species. The data shows a total of 13409 botanicals are used in Indian traditional medicine with Ayurveda (2559), Homeopath (460), Siddha (2267), Unani (1049), Sowa-Rigpa (671), as well as Folk medicine systems (6403).

The specific concentration of these phytochemicals with known chemical molecular structures is significant in the therapeutics of diseases in these systems of medicine. Traditional knowledge of the medicinal phytochemical content of plants enabled the development and manufacture of therapeutic traditional medicine formulations. This critique attempts to analyse the resultant impact on wellness management of phytochemicals sourced from cultivated medicinal plants vis-à-vis those from the plants growing in natural habitats. The question to ponder is how therapy can be poignant if the phytochemicals from farm-originated medicinal plants are used in place of those from natural biodiversity. The debate is whether the phytochemical molecules have the same biochemical structural integrity as well as concentration to impart definitive Pharmacognosis-based

bioefficacy in the final formulations for therapeutics.

Commerce of Medicinal and Aromatic Plants (MAPs)

Interest in medicinal plants and the therapeutic use of plant-based compounds has grown significantly in recent years. They are widely used to produce extracts, herbal medicines, health supplements, and beauty products, with their demand expected to outpace conventional drugs. India, with over 9500 registered herbal pharmaceutical / cosmetic industries and many unregistered herbal units, demands a continuous supply of various medicinal/ aromatic plants. The Ayush industry has increased significantly to US$ 18.1 billion in 2020, whereas it was US$ 2.85 billion in 2014-15 (PIB, 2023).

The India Brand Equity Foundation (IBEF)[3] Blog of 2020 on Healthcare provides a glimpse of the current scenario of demand and supply break up (wild source and farm source) of MPs. India has traded about 960 medicinal plants. About 178 species have yearly consumption levels of >100 metric tonnes. This accounts for 80 per cent of the quantity of medicinal plant species that are consumed by the pharma industries. Currently, 80 per cent of medicinal plants are harvested from the wild, while the rest of the MPs are from farms. Harnessing the raw medicinal plant materials from the gatherers in forests and in other landscape in the country serves the commission agents and brokers who supply large, medium and small industry units. According to the 'All India Trade Survey of Prioritised Medicinal Plants, 2019', demand for high-value medicinal plants increased by 50 per cent, while the availability declined by 26 per cent. According to Ved and Goraya (2007), about 12 per cent of plant species, totalling 21, are found in temperate forests, while 40 per cent (70 species) originate from tropical forests. Additionally, 20 per cent (36 species) are primarily cultivated or sourced from plantations, and 46 per cent are associated with roadsides and other degraded lands.

Recourse Depletion: Importance of Species Conservation

There is evident depletion of about 65 plant species ~10 per cent of total Indian medicinal plant species and have been categorised as endangered, vulnerable or nearly threatened categories by the National Biodiversity Authority, India. Prominent endangered wild medicinal plants are given in Table 1. Various Indian States have brought out respective lists of plant species, considering their maximised use in respective pharma industries. The relevant plant parts of this endangered flora are traded and can be judiciously separated from the plants without pulling them out, and throwing the unwanted plant parts away destroys the flora. Conservation ethics require the judicious harvest of respective parts, including seeds. Saved seeds can be further used for the multiplication of these plants in the same locality.

Medicinal plants used to be harvested from time immemorial from their wild habitat. Harnessing them from their natural habitats has thrown up challenges to the survivorship of various precious medicinal flora. There is an increase in the number of endangered medicinal flora in the country due to their overexploitation. The stakeholders, as well as the government

Table 1: Prominent Endangered Medicinal Plants in India

Sr. No	Scientific Name	Family	Plant part
1	*Aegle marmelos*	Rutaceae	Nodal segments and shoot tip
2	*Acorus calamus*	Araceae	Rhizome tip and Rhizome segments
3	*Celastrus paniculatus*	Celastraceae	Seeds, nodal segments
4	*Commiphora mukul*	Burseraceae	Leaf segments, apical nodal segments
5	*Peganum harmala*	Nitrariaceae	Seeds
6	*Prosopis cineraria*	Fabaceae	Seeds
7	*Simmondsia chinensis*	immondsiaceae	Nodal segments
8	*Spilanthes acmella*	Asteraceae	Nodal and intermodal segments
9	*Stevia rebaudiana*	Asteraceae	Apical and nodal segments
10	*Sapindus mukorossi*	Sapindaceae	Leaf segments, apical and nodal segments
11	*Bacopa monnieri*	Scrophulariaceae	Leaf explants and nodal segments
12	*Ginkgo biloba*	Ginkgoaceae	Apical and nodal segments
13	*Glycyrrhiza glabra*	Papilionaceae	Nodal segments
14	*Gymnema sylvestre*	Asclepiadaceae	Seeds
15	*Holostemma ada-kodien*	Asclepiadadeae	Nodal segments
16	*Oroxylum indicum*	Bignoniaceae	Nodal segments
17	*Picrorhiza kurroa*	Scrophulariacae	Nodal segments
18	*Saussurea lappa*	Compositae	Shoot tip
19	*Swertia chirata*	Gentianaceae	Shoot tip
20	*Tinospora cordifolia*	Meninspermaceae	Nodal segments

Source: Sharma and Thokchom, (2015)

entities, have since moved to their on-farm cultivation. The Government of India (GoI) has actively recognised the importance of medicinal plants and implemented various initiatives to protect and conserve these species. Conservation efforts have been carried out both in situ, such as within biosphere reserves, national parks, wildlife sanctuaries, and sacred groves, and ex-situ, including botanical gardens, field gene banks, seed gene banks, in vitro gene banks, and other facilities (Gowthami, 2021).

The research organisations geared up to undertake research on all aspects of medicinal flora as well as to develop strategies and protocols for their large-scale cultivation. In the interest of conserving the endangered flora and making it available to markets in large quantities, public institutions under ICAR and CSIR has been established. ICAR established

the Directorate of Medicinal and Aromatic Plants (DMAPR) and All India Coordinated Research Project on medicinal plants (www.htpps/dmapr.icar.gov.in). Valuable genetic stocks (Table 2) are conserved in this institution. The conserved germplasms are utilised for breeding purposes with the goal of enhancing their biomass and phytochemicals content. CSIR has established the Central Institute of Medicinal and Aromatic Plants (CIMAP) that maintains, after genetic improvement, around 2500 germplasm resources of fifteen Indian medicinal plant species are being carried out for higher biomass and the yield of phytochemicals in niche areas.

Domesticating Wild Species: Relevance of Promoting Medicinal Plants Cultivation

Since the ancient era, India has advocated and practised the utilisation of phytochemicals sourced from medicinally important plants for appropriate cures of various human ailments under alternative medical systems. Both diagnosis and treatment of human ailments were codified into well-recognised ancient scriptures. The identified flora was used to prepare homestead medicines from the plants that grow in the wild or are cultivated in homesteads.

Table 2: Field Gene Bank of ICAR-DMAPR

Number	Species name	Germplasm collection
1	Aloe Spp.	108
2	Anantamul (Hemidesmus)	39
3	Ashwagandha (Withania somnifera)	238
4	Babchi (Psorelea corylifolia)	27
5	Basils (Ocimum spp.)	416
6	Brahmi (Bacopa monnieri)	32
7	Chakoda (Casia tora)	129
8	Giloe (Tinospora codifolia)	52
9	Guggal (Commiphora spp.)	22
10	Isabgol (Plantago spp.)	211
11	Kalmegh (Andrographis paniculata)	130
12	Kostus (Costus speciosus)	35
13	Madhunasini (Gymnerma silvestri)	75
14	Palmrosa & Lemongrass (Cymbopogon)	37
15	Periwinkle (Catharanthus roseus)	17
16	Safed Musli (Chlorophytum boriviliensis)	56
17	Salaparni (Desmodium gangeticum)	133
18	Senna (Casia angustifolia)	253
19	Shatavari (Asparagus)	48
20	Roselle (Hibiscus subderifa)	12
	Total	2313

Source: ICAR - Directorate of Medicinal and Aromatic Plants (DMAPR).

In the last four decades, ICAR has established the Directorate of Medicinal and Aromatic Plants (DMAPR) and the All India Coordinated Research Project (www.htpps/dmapr.icar.gov.in). Valuable genetic stocks (Table 2) are maintained in this institution. They are utilised for breeding purposes with the goal of enhancing their biomass and phytochemicals of medicinal value.

The cultivation of medicinal plants for desired phytochemical extraction relies on various agro-climatic zones in the country. Variations in the quality and quantity of phytochemical content of medicinal flora are obvious. The manufacturing and exporting business houses have to standardise their raw material quality in terms of the concentration and quality of required phytochemicals. Cultivation following the Good Agricultural and Collection Practices (GACPs) promotes standardisation and quality assurance, thereby enhancing the acceptability of the Ayush systems globally and increasing exports of value-added items like herbal extracts, phytochemicals, dietary supplements, cosmeceuticals and Ayush products.

In 2000, the Ministry of Ayush, GoI, established the National Medicinal Plants Board (NMPB); it promotes the cultivation and sustainable use of medicinal plants in India through schemes like the Central Sector Scheme and Medicinal Plants Component of Ayush Mission. It supports farmers with subsidies, capacity building, and market linkages while fostering research and conservation initiatives. Ayush industry owners/extract manufacturers/exporters, etc., are responsible for participating in the cultivation of medicinal plants with a pre-decided price, buy-back agreement, and volume. They will share cultivation costs on the terms that are agreeable to the parties, clusters, farmers, industry owners, etc. Presently, the Ministry of Ayush has launched the Centrally Sponsored Scheme (CSS) of the National Ayush Mission (NAM). Under the 'Medicinal Plants' component of the NAM scheme supporting market-driven cultivation of prioritised medicinal plants in identified clusters/zones within selected districts of States and deployed in a mission mode across the country. As per the scheme guidelines, support is offered for post-harvest management with forwarding linkages, cultivation of prioritised medicinal plants on farmer's land, establishment of nurseries with backward linkages for raising and supply of quality planting material, primary processing of various plant parts of therapeutic ingredient value, marketing infrastructure, etc. Under this scheme, subsidy at the rate of 75 per cent, 50 per cent, and 30 per cent of the cost of cultivation is offered for the cultivation of 140 prioritised medicinal plants on farmer's land. Based on subsidy-based encouragement for selected MP cultivation in the country (Table 3), to satiate the domestic industry need, the necessary seed and planting materials are being produced and supplied to farmers by ICAR and CSIR research institutions.

The National Medicinal Plants Board (NMPB launched a "Voluntary Certification Scheme for Medicinal Plants Produce (VCSMPP)" on 22nd November 2017 to boost Good Agricultural Practices (GAPs) and Good Field Collection Practices (GFCPs) in medicinal plants. The VCSMPP will expand the availability of the certified quality medicinal plants' raw materials within the country and also solidify their export and amplify India's share in the global export of herbs. They have affiliated the major herbal manufacturing units are

covered under the following associations:

1. Association of Manufacturers of Ayurvedic Medicine (AMAM)
2. Ayurvedic Drug Manufacturers Association (ADMA)
3. Ayurvedic Medicine Manufacturers Organisation of India (AMMOI)
4. Association of Herbal and Nutraceutical Manufacturers of India (AHNMI)
5. Federation of Indian Chambers of Commerce & Industry (FICCI)
6. PHD chamber of Commerce and Industry (PHDCCI)

Influence of Farming Ecology on Phytochemical Metabolites of Medicinal Plants

The Indian Council of Agriculture Research (Ministry of Agriculture & Farmers Welfare) conducts research at the Directorate of Medicinal and Aromatic Plants Research (DMAPR), Anand (Gujarat) on the cultivation methods using high-yielding active biochemical principles of medicinal value in each of the medicinal crops. The institute has ICAR-All India Coordinated Research

Table 3: NMPB Subsidy for Cultivation of Various Medicinal Plants

Plants eligible for 30 per cent subsidy	Plants eligible for 50 per cent subsidy	Plants eligible for 75 per cent subsidy
55 species	27 species	13 species
Neem, Brahmi, Tulsi, Pippali, Isabgol, Ghritkumari, Dalchini, Tejpat, Kapoor, Chirmati, Vach, Adusa, Smaller Galanga, Kalmegh, Artemisia, Shatavari, Pashnabheda, Pinarnava, Senna, Patang, Sadabahar, Malkagani, Mandookparni, ShwetMusali, Arni, Aparajita, Patherchur, Shankhpushpi, Krsnasariva, Rotalu, Bringaraj, Amla, Kokum, Vai Vidang, Gudmar, Kapurkachari, Anantmool, Kurchi, Trivrit, Indian Crocus, Chandrasur, Konch, Bhumiamlaki, Bakuchi, Manjishha, Flannel Weed, Kathel-badhi, Makoy, Madhukari, Pawad, Arjuba, Bahera, Harad, Giloy, Nirgundi, and Aswagandha	Katha, Beal, Mulethi, Shirish, Varun, Gambhari, Chitrak, Agnimanth, Beejasar, Ashok, Timoor, Patala, Rohitak, Sarpgandha, Indian Valerian, Prishnaparni, Hrddhatri, Archa, Vidarikand, Nagakeshar, Jivanti, Pushkarmool, Kalihari, Sarivan, Atropa, and Satvin.	Chandan, Jatamansi, Atees, Agar, Guggal, Kutki, Raktachandan, Bankakri, Syonaka, Vatsnabh, Daruhaldi, Kuth, and Chirata.

Source: National Medicinal Plants Board, Ministry of Ayush, GoI.[4]

Project on Medicinal and Aromatic crops with 23 centres. The Ministry of Science & Technology has the Council of Scientific and Industrial Research (CSIR) institute, namely the Central Institute of Medicinal & Aromatic Plants (CIMAP). Both these research institutions have brought out many high-yielding crop varieties in terms of their biomass and increased phytochemical content. These research institutes have developed advisories to the farmers on suitable crop management methods for each of the medicinal crop varieties. Extensive cultivation of these crops contributes to the national demand for medicinal plant products every year.

150 varieties of 48 MAPs species, conserving and maintaining more than 2500 germplasm resources are maintained at CSIR-CIMAP Genetic improvement work of Mint species, Cymbopogon species, Ocimum species, Artemisia annua, Sylibum marianam, Withania somnifera, Catharanthus roseus, Papaver somniferum, Vetiveria zizinoides, Rosa damascena, Andrographis paniculata, Satawar species, Geranium, Patchouli, Chamomila recutita is being carried out for a higher herbage and also the yield of secondary metabolites. The first latex-free medicinal crop variety, "Sujata" in Papaver somniferum, is provided to farmers for cultivation. Genetic improvement of Indian Cannabis germplasms for developing low (<0.3 per cent) Tetrahydro cannabinol (THC) concentration.

Cultivation of medicinal plants (MPs) has become a profitable endeavour of many farms across the country (Janakiram et al., 2018). These crops have become part of relevant cropping systems in rainy seasons as well as in irrigated farms. Modern irrigation and other agro-techniques have been utilised in these farms to enhance their efficiency. Instead of chemical fertilisers and pesticides natural sources of plant nutrients and pesticides are used in these farms. This scheme of farming is expected to sustain regenerative agriculture as much as that in many horticulture farms. Intercropping MPs with orchard crops has become a rewarding practice for farmers. Following suitable cropping sequences and incorporating adequate organic matter into the soil, this goal to sustain agro-ecology is achieved. It would be desirable that large-scale MP crop production in big farms follow such practices that preserve the natural soil parameters of farms.

It is worthwhile to analyse whether modern farming practices influence the concentration and molecular structure, and configuration of various active biochemical compounds of therapeutic significance. In the current thinking on regenerative farming, where the least disturbance to farmland is visualised, conservation of soil organic matter and soil physical properties is emphasised.

Rainfed vs. Irrigated Farming Practices

Depending on the crop duration and biology, medicinal plants that are cropped in rainfed farms, if the rainfall is uniform and could provide soil moisture during growth and reproduction of crops. The soil physical properties of the respective agro-climatic zones in the country, including soil organic carbon content, would influence the optimum crop growth and reproduction. Rainfall is undoubtedly a critical factor affecting the cultivation of medicinal plants; however, prolonged or continuous rainfall can lead to the leaching of water-soluble compounds from leaves and roots, potentially reducing their therapeutic value.

Soil Organic Matter

This soil chemical parameter indicates the biological value of the farm soil in which medicinal crops are grown. It can

significantly influence the metabolism of crop plants and influence the synthesis of various active ingredients and their precursors. Poor organic matter content may result in fluctuations in the concentration and structural configuration of all active substances that offer medicinal properties. FYM, Green manure, city and farm waste compost, vermicompost and vermin-wash, crop residue management, mulching and concentrated manures are major sources of organic matter. Ideal crop plant growth may not be achieved, and the profitability of medicinal crop cultivation may dwindle. Since the MP crop market targets high quality of their medicinal value for higher price, farmers may stand to lose good prices if their MP produce is of inferior quality.

Seed and Planting Materials

Government, public research institutions and Farm Science Centres (Krishi Vigyan Kendras) provide seeds and planting materials for most of the cultivated medicinal crops. Tissue culture-based planting materials of many medicinal plants are also readied for distribution to farmers. Many private nurseries have a good stock of their seeds and planting materials.

Crop husbandry

In addition to the normal cultivation practices such as land preparation, application of adequate quantity of manure and fertilisers for each medicinal crop species, sowing of seeds/placing of vegetative parts in soil at the appropriate crop season and soil moisture level, interculture operations, weeding, etc. are regularly undertaken to enable good crop growth. Foliar application of plant nutrients, based on the soil nutrient status, may be needed for optimising crop growth and MP commodity production. The use of animal dung and urine in crop husbandry of medicinal crops has become considerably popular.

Crop Protection

As intensive farming of medicinal plants increases, problems of biotic stresses in these crops due to pests and diseases become a crop husbandry routine. Natural (biological) pesticides such as neem oil, neem seed kernel water extract, karanja oil, and microbial pesticides are very handy options to contain insect/mite pests and diseases of MPs. Chemical synthetic pesticides are not desirable for the protection of MP crops. Most MP crops do not have legal label claims for using chemical synthetic pesticides to suppress pests and diseases; farmers use these mostly without following transparent Good Agriculture practices. The potential residue of such pesticides for these crops has to be monitored, especially where the given plant parts from the target flora are used immediately after harvest.

Post-harvest Management

The economically important plant part(s) that bears the phytochemicals of medicinal importance need to be prudently conserved before the processing is taken up to extract those components. Post-harvest management of commodities hence becomes significant to harness the maximum yield of the active principles for the manufacture of various medicinal preparations in the traditional medicine systems.

These processes do influence the quality and quantity of active principles of therapeutic value in various flora. Agro-climate and edaphic factors are known to influence the medicinal characteristics of desirable flora in comparison to the natural flora. Sourcing these plants from either means needs a careful pilot study about the pharmaco-therapeutic and pharmacognosy value. Reputed manufacturers, under the guidance of experts in the field, shall

have such evaluation data generation as per statutory requirements. Many of the MSME processors blend both natural and cultivated flora species at definitive ratios to formulate their products for their best bioefficacy.

Power of Active Principles

The active phytochemicals present in medicinal plants as products of their metabolism are found to possess curative properties for human ailments and those in certain livestock animals (Tiwari et al., 2014). Traditional knowledge about various active biochemical ingredients of any given medicinal plant guides physicians in the treatment of various ailments in most of the traditional medicine systems in India and elsewhere in the world. Based on the elucidation of the structure-function of these biochemical molecules, modern medicine systems have been utilised for different therapeutic purposes in all medicine systems. To illustrate this point, let us consider the commonly known medicinal plant Ashwagandha (Withania somnifera). It is a remarkable herb with a long history of use in Ayurvedic medicine. Its therapeutic ingredients are Withanolides (Bodke & Patil, 2021). These are different from ginseng although they have structurally similar chemistry. One of the constituents of Withanolide is Withaferin-A, which is known to be hepato-protective. Many steroidal alkaloids and lactones are known to offer stress reduction, enhanced immune response and antioxidant effects. These have analgesic and anti-inflammatory activities due to their inhibition of cyclo-oxygenase (Tiwari et al., 2014). Some reports about its adverse effects also need to be considered if continued for over three months, known to cause stomach upset and, in some cases, liver damage, miscarriage, and thyroid hormone dynamics. It is known to be undesirable for use by lactating mothers and those with prostate cancer (Handwerk, 2024).

Another commonly known and used medicinal plant is Musli (Chlorophytum borivilianum Sant. & Fernandez, C. arundinaceum, C.tuberosum.C. malabaricum,. C. attenuatum, C. breviscapum). Saponin is the key biochemical constituent in its roots that offers aphrodisiac properties. Widely cultivated in India, this medicinal herb is harvested and sun-dried for processing in various medicinal preparations.

These herbs are collected from the wild, such as forests, non-agricultural lands, etc., by local people and supplied to local traders. Such bioresource gatherers are the pivot of the supply chain of medicinal herb raw materials. These gatherers undertake the initial process of such natural resources by sun-drying to reduce their weight. Traders also demand the dried plant tissues (stem/root/leaves etc.) to be made into small pieces.

It is by now evident that crop breeding to improve the medicinal ingredients has resulted in improved MP varieties. However, their cultivation under near-natural conditions and practice would ensure high-quality raw materials for the pharmaceutical industry. Many large manufacturers having their own farming also have utilised these public varieties for cultivation. The national productivity of medicinal flora crops has increased leaps and bounds due to the immense support of National Medicinal Plant Board subsidies (Table 3). They undertake contract farming wherein such cultivated flora is bought back for the manufacture of medicines. The left-over plant parts are composted for recycling into farm soil by farmers. The State Biodiversity Boards under the National Biodiversity Authority encourage the cultivation of medicinal plants in fringing forests as well as in forest communities and tenements.

Research on comparative phytochemical concentrations and their quantity has shown in many countries that there is a higher concentration of MPs growing in the wild lands in comparison to those harvested from farms. The Pharma industry is conscious of this fact and hence has strategies to optimise the final concentration of medicines in their formulations. The balance to be struck is to encourage process modifications to accommodate wide variations of phytochemical concentration in the raw materials available in their trade.

Conclusion

Large-scale cultivation of various medicinal plants has become a recognised practice in our country. It would be unwise to conclude that the therapeutic value of the major medicinal flora may not fluctuate drastically. There is scope for continuing research to understand the intricacies of the quality and quantity of active principles of flora grown in both cultivated and natural habitats. The related therapeutic value can be evaluated appropriately. Various research institutions under the Indian Council of Agriculture Research (Department of Agriculture and Farmers Welfare, Ministry of Agriculture and Farmers Welfare) and Council of Scientific and Industrial Research (Department of Scientific & Industrial Research, Ministry of Science and Technology) have established protocols for breeding and cultivation of over 175 medicinal plant species that have specific phytochemicals through pharmacognosy for use in various traditional medicines in India and other countries. Indian ayurvedic pharmaceutical firms have established large farms to cultivate medicinal flora that are commonly utilised in their medicine manufacturing. The pharma industry, along with public bodies under forest, commerce, agriculture, science and technology ministries, could converge for synergy to garner their strength of knowledge and technology that can be fruitfully utilised to enhance the quality of raw materials and the medicinal formulations from them.

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Re-Branding Ayush Products for Export Growth: Role of Bioactives, Superfoods, Geriatric Labels

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Abstract: Rebranding Ayush products as "herbal, bioactives, superfoods and green holds immense prospects for export. Many medicinal plants are now cultivated and contain many bioactive compounds. For instance, "Asparagus" is emerging as a "superfood" in the West, with shoots used for soup making while roots that are 10 times more healthy are used in Ayurvedic drug making. Ashwagandha, another Ayurvedic tonic in high, is also cultivated like Isabgol (Psyllium), Senna, Turmeric, Licorice and Tulsi (Holy basil), with no risk of wild harvest/species extinction. Targeting western diseases, especially of the elderly, such as Alzheimer's, Cancer, and irritable bowel syndrome (IBS), can boost Ayurveda drug export. The modern medicine has limitations in managing such chronic/lifestyle ailments. As shown by traditional Chinese medicine (TCM) in the past three decades, to be the global leader in herbal exports, innovation is required. Nutrition, cosmetics, sanitary, cattle feed and antimicrobials are lucrative segments for Ayush exports. Communicating in modern, scientific terms for popular appeal is key to business growth, as opposed to using age-old traditional terms/concepts that are hard to understand. Ayush exports of about $1 billion/ year comprise about 25 per cent of their turnover in India, but this can double in 2030 with the rebranding suggested above for popular appeal.

Keywords: Traditional medicine, Regenerative, Health, Antioxidant, AMR

Introduction

Herbal medicines (HM) of traditional medicinal (TM) systems such as Ayurveda, Unani, Siddha, and Homeopathy (termed Ayush) are becoming increasingly popular recently due to their conceived safety (no adverse drug reaction- ADR, i.e. side effects)

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and slow but sure relief in especially lifestyle/ chronic ailments such as diabetes, hypertension, arthritis etc. where modern medicine has limited drugs or effect. This is evident from the meteoric rise of several Ayurveda manufacturing firms like Patanjali Ayurveda Limited Co. Ltd, with revenues of over $ 1 billion/year (from all segments, including FMCG, Sharma *et al*., 2019) in the past decade.[1] Other Ayurveda/traditional medicine companies have also grown well due to the overall sectoral boom (PIB, 2022). Earlier, it was proclaimed that TM would grow manifold, like biotech and IT (information technology), but it did not happen for several reasons related to the gap in demand-supply and communication strategies. Firstly, the disease burden of export markets is different from India, where cancer, coronary heart disease (CVD), and respiratory and musco skeletal issues prevail (Table 1). So, Ayurveda needs to address the demands of these markets. Secondly, communication in modern, simple, scientifically understood terms is another capacity Ayurveda must build to tap the Western consumers and health professionals as PAL successfully did by selling its wheat flour biscuits instead of competing "refined flour" biscuits using the "transfat" concept. Customer education regarding product value and new health concepts is a critical tool for publicity and promotion. A unique selling proposition must be appealing to and understood by the market. The Tridohsa (3 humours) theory may be relevant in India, but its physiological interpretation needs to be explained globally (Hankey, 2010; Rastogi, 2010; PIB, 2022). In fact, some even correlated with genetic typology, termed "Ayurgenomics", and opening new school of thought (Prasher *et al*. 2016).

Disease Profile of Major Markets

The disease profile in the Western countries, i.e. the developed world, including Australia, differs from India as depicted in Table 1. Arthritis and allied musco-sceletal diseases top in prevalence, followed by Injuries, CVD,

Table 1: Comparative Disease Profile of Major Markets

Disease	USA per cent	EU per cent	India per cent
Musculo-scalatal	41	33	3
Injuries	29	-	-
Heart	13	11	9
Cancer	9	4	4
Bronchitis	16	-	-=
Respiratory	11	10	6
Dementia#	5	-	-
Injuries	4	-	3
Diabetes	12	6	-
Brain stroke	3	-	3
Hypertension	2	18	-
Neurological	17	-	-

Soruce: Mokdad *et al*., (2018); Huijts *et al*., (2014); Menon *et al*., (2019).

cancer, respiratory ailments (including Asthma) and mental issues (Dementia, Alzheimer, Depression etc.). These are limited in India, where still issues such as infant-maternal mortality, malnutrition, and gastric issues prevail, as in the rest of the developing/third world.

A recent analysis of Global Burden of Disease (GBD) 2019 data showed that approximately 1.71 billion people globally live with musculoskeletal conditions (Huijts *et al*., 2014), including low back pain, neck pain, fractures, other injuries, osteoarthritis, amputation and rheumatoid arthritis (Nguyen *et al*., 2024; GBD, 2021) 1. While the prevalence of musculoskeletal conditions varies by age and diagnosis, people of all ages everywhere around the world are affected. High-income countries are the most affected in terms of number of people – 441 million – followed by countries in the WHO Western Pacific Region with 427 million and South-East Asia Region with 369 million.[2] It is further said that the musculoskeletal conditions contribute most to the years lived with disability (YLDs) globally, accounting for 17per cent of all YLDs worldwide, with about 149 million YLDs. Ayurvedic drugs are found to be effective at par with the standard- methotrexate in treating Rheumatic arthritis in clinical trials in Europe (Furst *et al*., 2011).

Table 2 depicts some other common diseases being addressed by Ayurveda drugs based on clinical trials/ research with promising results. Some of these drugs are called "Rasayana,", i.e. rejuvenators, as they help to revive vitality and defy age, so they can be very useful as a tonic for the elderly population whose share in the population is rising globally (Baliga *et al*., 2013). These are only promising examples, and much more research is needed for its validation and to add more drugs and ailments to the TM portfolio.

Smart Products from Permitted Botanicals

Europe and the USA, amongst other developed nations, prohibit the use of many major ingredient species of Ayush drugs, as their safety and efficacy are not proven using Western methods. Hence, a smart approach will be to develop "smart" drugs from spices and herbs that are permitted in those countries. These include (Table 3), for instance, in Germany in the EU.

Table 2: Promising Ayurvedic Treatments

Disease	Place	Remedy	Remark
Cancer	Multi-centre (Arnold, 2023)	Turmeric, Black pepper, Indian Berberis, Triphala	Validated by USA researcher
Dementia/ Alzheimer's	USA (Farooqui et al 2018; Gregory et al., 2021)	Ashwagandha, Bramhi, Turmeric	Herbs can help to manage the AD
Irritable Bowel Syndrome	Berlin (Jeitler et al, 2021; Verma et al., 2024)	Fennel, Anise, Cardamom, Cumin, Ginger, Asafoetida	Ayurveda significantly reduced IBD extent

Source: Authors own compilation.

Note - Ashwagandha- Withania somnifera, Bramhi- Bacopa monnieri,. Long pepper- Piper longum, Indian Berberis- Tinospora cordifolia, Triphala- Haritaki (Terminalia chebula), Bibhitaki (Terminalia bellirica), Amalaki (Emblica officinalis), Turmeric- Curcuma longa.

Table 3: Indian Herbs Included in the Western Pharmacopeia and Applications

Medicinal Plant	Bioactive	Applications
Adhatoda vasica- Vasaka	Vaccines	Arthritis, Respiratory**
loe vera- Aloevera	Acemannan*, organic acids#, Tocopehrols	Dermatitis
Asparagus racemosus- Satavar	Steroidal saponins	Tonic, vitality, Galactogouge
Commiphora wightii- Guggulu	Polysaccharides	Arthritis
Cassia angustifolia- Senna	Sennesoides	Digestive
Ferula asafetida- Asafetida	Asaresinotannol, ferulic acid, umbelliferons	Digestive
Glycyrrhiza glabra- Licorice	Glycyrrhizin	Cough, cold
Morinda citrifolia- Noni	alkaloids, flavonoids, anthraquinones, saponins, scopoletin	Multiple uses, tonic, arthritis
Urtica dioica- Nettle*#	flavonoids, phenolic acids, amino and fatty acids, carotenoids	arthritis, gout, rheumatism, anemia
Withania somnifera- Ashwagandha/ Indian Ginseng	Withanolides	Tonic, insomnia , rejuvenating

Source: Authors own compilation.

*- a bioactive acetylated glucomannan #- oxalic, quinic, and malic acids

*#- benign prostatic hyperplasia (BPH) (Safarinejad, 2005).

**- (incl. Bronchitis).

Already, some researchers/companies, such as Natural Remedies, Bangalore,[3] are tapping this permitted herbs list to develop inventive products by modifying the existing herbal drugs. One such example is below-

1. Vasa (*Adathoda vasica*) extract,
2. Novel Herbal mixture- Vasa, Tulsi (*Occimum sanctum*).

The recent rise in the importance of TCM and Ayush in the Corona pandemic must be tapped. Other spices, such as Coriander, Cumin, Black Pepper, Turmeric, etc., are routinely used in food in Europe and America and are Generally Considered Safe (GRAS). Their use in the medicine may require fresh permission as their use is also specified with respect to purpose and dosage, but food supplement regulation is weak in the USA, so there is a marketing scope (Ghate & Wele, 2022).

A few other herbs exported from India are not mentioned in the above list, but other species in the same Genus are listed as shown below in Table 5. So, adding Indian species to it would require some studies and documentation. Tulsi, i.e. Sacred basil (Occimum sanctum)/ its relatives, are approved in many countries, so its licensing may be easy. Table 4

enlists spices that are already included in European and German pharmacopeia.[4] Similarly, Triphala was recently included in the pharmacopoeia in the USA (Yearsley, 2020). Since some herbs such as Nirgundi-Vitex negundo- are included in British Pharmacopoeia already[5] it may be easier to seek their inclusion in the EU list. Some herbs are in the permitted foods list, such as Asparagus in the USA, used as a vegetable/in soup making, and much imported from Latin American countries.[6] However, secondary metabolite content such as saponins is 10 times higher in its roots than in shoot (Alcaide *et al*., 2023) that are used as medicine in Ayurveda (Oli *et al*., 2024). Adding Asparagus roots to western Pharmacopeia is needed and may be easy to obtain as its aerial parts are already permitted as food. This boosted huge root export options as Mexico, Chile, and Peru exported 200 million tons of Asparagus shoots worth $ 85 million in 2020 to the USAv . It is nearly 6 per cent of total Indian Ayush herbs export of about $ 1.5 Billion in the same period.1 Satavari trade in the year 2007 was reportedly up to 2,000 (two thousand tons/ year) across India in 2017 (Goraya & Ved, 2017)) and at an 11 per cent annual growth rate quoted there, it can be estimated at about 3,000 tons/year in 2020. Roots volume is only 20 per cent of the full plant volume in Satavari (Darokar, 2021). So the shoot volume can be 12,000 (twelve thousand) tons, which presents a huge opportunity only in the USA market. EU and middle-east markets can add to it later.

Higher export is possible if by branding higher metabolite content, better quality/ potency, i.e. is demonstrated and no pesticide residue and other phytosanitary measures. For instance, application of potassium fertiliser, including on organic methods manures such as ash and mycorrhiza (microbial biofertiliser) inputs to soil and with superior variety and seed/ quality planting material, can improve the Curcumin content in Turmeric to 8 per cent, which is 4 per cent on average (Ghate *et al*., 2019). Natural farming missions recently mooted by the Indian government can help to reduce or avoid chemical residues on the exported foods/herbs.[7] Further, to enhance marketing, aligning with famous brands will be useful, such as calling the Ashwagandha herb "Indian" Ginseng to tap into the popularity of the latter (Grandhi *et al*., 1994). TCM is already popular in many countries and Ayurveda can bank on it to further extending own market through R&D and publications, policy dialogues, exhibition-promotion (Patwardhan *et al*., 2005).

The paper checked the medicinal applications of the top traded herbal species in pharmacopeias from major markets from literature such as Chamomile, Gingko, Ginseng, Ivy leaf, Primrose, St. John's wart, Rosemary etc. (Bommakanti *et al*., 2023). The paper compared it with the top species in the Ayurvedic trade (Patwardhan *et al*., 2004; Vaidya *et al*., 2007; Samy *et al*., 2008;). Some, like Asparagus, have multiple uses, e.g. tonic, for lactation (Gupta & Shaw, 2011), for menorrhagia (Ghate *et al*., 2022) and as an adaptogen (Majumdar *et al*., 2021). Such multi-purpose species may be able to substitute the western species whose cultivation in the Indian tropical climate may not be feasible in the field conditions as these grow in the temperate region.

Emerging Scope and Concerns

Ayurveda and allied TM systems, such as Unani, Siddha, Homeopathy, etc., can benefit by demonstrating their efficacy in

addressing net age challenges rather than merely the traditional disease pattern. One such utility has been immunity boosting by regular spice decoction consumption by the Indian population that may have helped its much lower infection rate (30,000 per 1 million population, i.e. 60-70percent lower than most EU nations and USA- at >200,000 per 1 million) and mortality from COVID-19 (368 per 1 million people i.e. 1.2 per cent of the patients, which was >1,000 and 2-3 per cent respectively for most EU nations and even in South America) (Ghate and Kulkarni, 2021, 2023). Other south Asian nations also show similar lowest infection and mortality rates as Pakistan, Bangladesh and Nepal. This may be due to higher spices consumption, rich in antioxidants, besides higher exposure to sun that helps in more vitamin D production, as also due to less consumption of industrial, package food and beverages that risk the immunity evident in the western world (Ghate & Kulkarni, 2022).

Rising European Imports of Ayurveda Medicines, Herbs and Spices

Realising the health benefits of Ayurvedic herbs and and spices, EU import of spices and even Ayurvedic products from India has increased post-pandemic (CBI, 2023).[9] These include Ashwagandha, Bramhi, Gotu Kola, Neem, Triphala, and Tulsi. Europe imported 237 thousand tonnes of MAPs, worth USD 1.3 billion in 2022 (CBI, 2023). Since 2018, EU imports have increased annually at a 2.1 per cent average rate in terms of volume and value-wise, it is 9.1 per cent per annum (ibid.). This

Table 4: Common Uses of Spices Included in EU/German Herbs List

EU List[8]	**Ayurveda Use**	**Germany** (Yearsley, 2020)	**Ayurveda Use**
Aloe	Skin	Asafoetida	Digestive
Clove	Toothache	Grapes	Tonic
Caraway	Antiseptic, cough, skin, wounds, liver	Guggul	Arthritis, joint pains
Cardamom	Diabetes, high cholesterol, fatty liver	Kalmegh	Fever
Cinnamon	Diabetes	Licorice	Cough
Garlic	Blood pressure, heart	Mint	Cough-cold
Ginger	Fever, Pain, Nausea,, Cough, antimicrobial	Pepper	Cough, fever
Gotu kola*	Tonic, memory booster	Salai	Arthritis, joint pains
Senna	Digestive	Satavar	Tonic, lactative
Turmeric	Antibiotic	Thyme	Digestitve, pain, hangover, skin care
Vitex agnus-castus#	Pain	Vasa	Cough, infection

Source: Authors own compilation.

*- Centella asiatica (mandukparni in Ayurveda- Srilankan vegetable, boosts memory, immunity) (Gamage and Kumara, 2015).

#- its related sp. Vitex negundo- Nirgundi- is a major joint pain relief drug in India and China.

increase is explained by rising demand and more costly raw materials. About 52 per cent of European imports (by value) originated from developing countries in 2022, which is 6 per cent over the 2018 value. (ibid.). Thus, developing countries are increasing their supply of medicinal and aromatic plants to Europe. The largest non-EU supplier of MAPs to Europe is India, with imports worth USD 163 million in 2022 (CBI, 2023); China being next valued at USD 69 million/ year. Higher consumption of spices and fruits-vegetables may improve the health and well-being of the elderly people whose share in Europe is high and growing much globally recently (Kulkarni & Ghate, 2024).

Emerging Health Challenges and Business Scope for Ayush Herbals

Immunity

Table 5 enlists major emerging segments of the health business for Ayurvedic/ herbal treatments, starting with immunity protection/ improvement. The mechanism of action in immune-modulation includes the enhancement of T helper (Th) cells and natural killer cells are two main ways by which Ayurvedic herbs are found to boost immunity (Vallish *et al*, 2022). Since immunity is a natural ability of the human body and there is no pill to correct it, herbs consumption is rising globally, including Ayurveda. Ayurvedic drugs are made up of herbs but are processed in ways to refine them and make them more effective such as boiling for a long time, mixing with adjuvants such as Ghee (lipid medium- clarified butter) and honey etc., as efficient carriers, which can be said to be traditional nanotechnology (Ghate & Wele, 2022). Thus, Ayurvedic medicines like Triphala may protect or enhance immunity better than raw drugs/ simple, single herbs. Turmeric latte (milkshake), the emerging global fashion, is also better than Turmeric water as its bioactive ingredient "curcumin" is lipid soluble but insoluble in water, so the former leads to higher bio-absorption and efficacy (Aggarwal *et al*., 2011).

Anti-Microbial Resistance (AMR)

The worldwide rising anti-microbial resistance among pathogenic microbes is a grave concern as it leads to the failure of anti-biotics such as Penicillin that ruled the 20th century (Joshi *et al*., 2024). This is caused by overuse or misplaced use of antibiotics and the infections of livestock origin due to animal products such as milk, meat, and eggs that humans consume. Ayurvedic medicines have the potential to address AMR (Patwardha & Unnikrishnan, 2018). The main Ayurvedic drug "Triphala" was reported to exert antibacterial effects on both gram-positive and gram-negative species in vitro and even demonstrated the potential to eradicate enteric pathogens in vitro (Peterson *et al*., 2017). Convalescent care after antibacterial use Antibiotics can be a very powerful factor in causing an imbalance of the intestinal microbiota (Sijna *et al*., 2021). Ayurvedic herbs as prophylaxis-based modern surgery of Benign Prostate Hyperplasia (BPH) surgery was successful without any antibiotic at Meerut (Yadav *et al*, 2017). Such anti-microbial potential of Ayurvedic drugs is crucial due to the rising global burden of infections, such as chikungunya and Dengue (Mohapatra *et al*, 2024).

Global patient deaths due to antibiotic resistance are approximately 700, 000 and the numbers are expected to increase to 10 million by 2050 without effective measures.

Table 5: Emerging Business Segments for Ayurveda/Herbal Drugs

Segment	Herbs species	Remarks
Immunity (Vallish et al, 2022)	Ashwagandha, Asparagus, Ginger, Giloy, Turmeric	Enhancement of T helper cells and natural killer cells
AMR- Anti microbial resistance	Triphala, Giloy, Turmeric, Neem, Tulsi, Drumstick[52]	Direct- of host- acting flavonoid compounds (DAC/ HAC) (Song et al, 2022)
Cattlefeed/ ethno-Veterinary (Rastogi et al, 2015)	Asparagus, Bhuamla, Gokharu, Tulsi, Giloy, Punarnava, Coriander	They build the livestock immunity and many herbs have common action in humans[10]
Cancer	Turmeric, Ginger, Giloy, Ashgourd	These may act on telomere or p450 pathway
Elderly health	Triphala, Chyavanprash, Sesame oil, Bramhi	Called "Rasayana" compounds, these reduce oxidative stress
Beverages	Lemongrass, Tuli, Mint, Ashwagandha, Chinarose	These are also powerful and delicious antioxidants
Cosmetics	Bhringraj, Henna, Sandal, Chinarose, Jasmine	This is the premium segment to avoid the skin risk by chemicals
Aromatherapy	Patchouli, Lavender, Tulsi, Sandal	This is emerging branch like Yoga and Meditation therapy
Natural Dyes (Dey and Nagababu, 2022)	Beetroot, Catechue, Pomegranate (Drema *et al*, 2024), Turmeric	Just began to avoid carcinogens etc. in food/ cosmetic dyes
Sanitary/ Hygiene (Sharma *et al*, 2019)	Neem, Tulsi, Sandal, Soapnut, Shikakai	Important since COVID-19 due as hygiene is crucial for health

Source: Authors own compilation.

Cancer

Cancer is the 2nd leading cause of death in the world, causing 10 million, i.e. 16 per cent of global deaths in 2018, according to World Health Organisation (WHO) data.[11] There were two times as many new cases reported in 2022. The mode of action against cancer of over 10 important Ayurvedic herbs is mentioned elsewhere to propose them as an adjuvant to reduce risk and better elderly life (Kulkarni Ghate, 2023, 2024).

Other Emerging Challenges-

Further, new disease categories are emerging as important and rising their share in the global burden of diseases such as mental health comprising anxiety, depression, suicides due to the growing misuse of communication technology, social isolation[12] and the immense workload (Bondanini *et al*, 2020). Herbs such as Ashwagandha and Asparagus are very useful for sound mental health as they have nootropic, neuroprotective and adaptogenic effects, as stress relievers (Majumdar *et al*, 2021). Ashwagandha is also useful to treat insomnia (Borse *et al*, 2021). An Ayurvedic startup is doing roaring business and rapid growth by focussing on baby care range.[13]

There were concerns earlier regarding the safety of Ayurvedic drugs, especially the use of heavy metals in it's that may be

carcinogenic and even their prohibition (Ghate & Wele, 2022). However, research by premier institutes like the Bhabha Atomic Research Centre (BARC), Mumbai, showed that it has therapeutic benefits but no ADR (Srikanth *et al*., 2019). Finally, simple, catchy, pro-patient drug names and labels will help to quickly tap the market and capture it soon. For instance, the names of Sharangdhar pharma co., Pune drugs are noteworthy- e.g. "Dybogen" for diabetes, "Pylowin" for piles, "Harto" for heart-care, than the difficult Ayurvedic text names, e.g. "Mahavishgarbh tail", "Arshkuthar Rasa", "Avipattikar Choorna".

Conclusion

The paper suggests the following strategies for rapid growth in Ayurvedic exports -

1. Focus on cultivated herbs, especially spices, as they are permitted in food or often in pharmacopoeia also globally,
2. Aim to add key Indian herbs, such as Triphala or Bramhi, to western pharmacopoeia, to enable the export of Ayurvedic drugs there for medical purpose, and not as "food supplements" as is common today,
3. Get requisite plant parts usage in medicine, with respective policy approvals, such as Asparagus roots, which are highly medicinal due to 10 times secondary metabolite content than shoots that are in regular diet as soup.
4. Target Western ailments such as dementia, digestive and mental health issues rather than the traditional Indian diseases in the text.
5. Promote research and development and publications in international journals to seek approval for new uses or new species or plant parts.
6. Improve communication to be user-friendly, naming drugs with catchy, self-explanatory names for easy understanding by the customer.

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Price Dynamics of Ashwagandha (*Withania somnifera*) in India

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Abstract: Ashwagandha, often called Indian ginseng, Indian winter cherry is a game-changing herb in Indian traditional medicine, and its demand in the global pharmaceutical market is soaring. Known for its adaptogenic properties, it is gaining popularity for stress relief, boosting immunity, and enhancing overall well-being. As demand surges, understanding the market dynamics of this prized herb has become essential. This study dives into the price trends and market linkages of Ashwagandha, analysing fortnightly data from November 2017 to March 2020 across five key markets: Neemuch, Shivpuri, Dhamtari, Kolkata and Mumbai. All the markets except Neemuch have exhibited a declining trend in prices over the study period. Price fluctuations were observed across all markets, with Mumbai showing the highest volatility, closely followed by Shivpuri. The co-integration analysis indicates the existence of long-run market linkage; the Granger causality test reveals that a few market pairs exhibit a significant causal relationship in price formation. This limited price transmission calls for needed strategies for effective marketing of Ashwagandha.

Keywords: Ashwagandha, Prices, Co-integration, Granger Causality, Market

Introduction

Over the years, medicinal and aromatic plants have gained increasing recognition in the pharmaceutical industry and traditional healthcare systems globally, offering great potential for agricultural diversification (Phondani *et al.*, 2016). India, often referred to as the 'Botanical Garden' or 'Medicinal Garden' of the world, is home to a vast array of medicinal plants (Gowthami *et al.*, 2021). Due to the country's diverse agro-climatic conditions, around 7,500 plant species have been documented for their medicinal uses in both

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indigenous health practices and modern medicine (Sharma & Pandey, 2013). India's medicinal plant industry plays a crucial role in supporting the livelihoods of farmers, herbalists, and manufacturers (Rasul et al., 2012) while also standing as a leading exporting county with exports of raw herbs, extracts, essential oils, and herbal formulations (Singh & Kumar, 2022).

Isabgol, Henna, Senna, Mentha,Tulasi, Ashwagandha, and Ghritkumar are the major cultivated medicinal plants species in India. Ashwagandha (Withania somnifera) plays an important role in indigenous traditional medicine like Ayurveda in India. It is also known as the Indian ginseng, Indian winter cherry or the Vitania sluggard. In recent year, there has been a significant upsurge in demand in the usage of it in pharmaceuticals with its active compound of withanolides and alkaloids (Mikulska *et al*., 2023). India is the leading producer and supplier of Ashwagandha across the globe, with exports of USD 3.44 million in 2023-2024[1] (Pandey *et al*., 2024). Ashwagandha is cultivated across 10,780 hectares in India, producing 8,429 tonnes, with Madhya Pradesh, Gujarat and Haryana being major producers. Madhya Pradesh is its hub and primarily cultivated in the Manasa, Neemuch, and Jawad blocks of the Mandasaur district.[2] Neemuch is the hub for Ashwagandha trade in India, with annual trade of more than 2000 ton, produce from Rajasthan and Andhra Pradesh is also brought to Neemuch for sale (Goraya & Ved, 2017). It is a financially viable cultivated species, offering a gross return of Rs.2.23 lakh per hectare against a production cost of Rs.1.12 lakh per hectare.[3] Gujarat, Himachal Pradesh, Punjab, Uttar Pradesh and West Bengal collectively consume around 96 per cent of Ashwagandha.[4] Dadhich et al. (2024) also reported that farmers get Rs 256 from the investment of Rs.100 from the hectare of land. It is also one of the key herbal raw materials traded in herbal markets, with a volume ranging between 4,000 and 5,500 tons, primarily in the form of root products (Goraya & Ved, 2017). The NMPB had launched the "Ashwagandha: A Health Promoter" campaign to raise awareness of its health benefits and encourage the planting of Ashwagandha in public spaces, educational institutions, homes, and forests, while also motivating farmers and tribal communities to cultivate it for sustainable raw material supply to the Ayush sector and herbal industries (Dadhich *et al*., 2024).

Although many ethno-botanical studies have been conducted on Ashwagandha, research focusing on its economic viability, export potential, and market dynamics remains limited. Notably, the aspect of market behaviour, particularly prices over time and across different markets, has been largely unexplored. Price fluctuation is common in agricultural commodities and arises from year-round demand, short shelf life, seasonal output variations, weather changes, and market imperfections like flawed auctions, hoarding, and speculation. In agricultural markets, market integration plays a crucial role in enhancing the efficiency of marketing systems by influencing price transmission between spatially separated markets. It promotes the efficient operation of separate markets, which pay fair prices to producers and make produce available to customers at fair prices (Kumar & Gajanan, 2022). Market integration can be measured in terms of strength and speed of price transmission between markets

across various regions of a country (Ghafoor *et al*., 2009). Several empirical studies have been undertaken using co-integration techniques related to the market integration of agricultural commodities in India. This study aims to bridge the gap by exploring the price dynamics of Ashwagandha across selected markets, while also analysing the market linkages that influence price fluctuations and drive overall market efficiency for the same.

Data and Methodology

The present study is based on secondary fortnightly time series data sourced from the e-CHARAK (e-Channel for Herbs, Aromatic, Raw material And Knowledge) platform of the National Medicinal Plants Board. The data covered for selected markets from the first fortnight of November 2017 to the second fortnight of March 2020. Due to the unavailability of regular data beyond this period, those points were excluded from the analysis. The markets considered for the study included Neemuch, Shivpuri, Dhamtari, Kolkata and Mumbai. Missing values in the dataset were handled through appropriate imputation techniques to ensure data completeness. To analyse the price dynamics and assess market linkages, a combination of statistical and econometric tools was employed. The econometric analysis was conducted in several stages.

Augmented Dickey-Fuller Test

First, Augmented Dickey-Fuller (Dickey and Fuller, 1979) a unit root test was performed to examine whether the time series is stationary. If any series was found to be non-stationary, differencing was applied to achieve stationarity.

$$\Delta y_t = \alpha_0 + \alpha_{1t} + \delta y_{t-1} + \sum_{i=1}^{m} \beta_i \Delta y_{t-i} + \varepsilon_t$$

The change in the time series, represented as ΔYt captures the variation in Y at time t compared to its level at t−1. The null hypothesis states that δ=0, while the alternative hypothesis posits that δ<0. Rejection of the null hypothesis indicates that the time series is non-stationary and requires differencing. Once it is confirmed that all price series are stationary in the same order of integration, a co-integration analysis is performed.

Johansen Co-integration Method

Once stationarity was confirmed, long-run relationships between the markets were investigated using the Johansen co-integration (Johansen, 1988) method. This approach helped to determine whether a stable long-term equilibrium relationship existed between the prices in the selected markets. The null hypothesis of at most 'r' co-integrating vectors against an alternative hypothesis of 'more than 'r' co-integrating vectors were tested by the trace and eigen value statistic given below.

$$\Delta Y_t = \sum_{I=1}^{P-1} \Gamma_i Y_{t-1} + \Pi Y_{t-1} + \varepsilon_t$$

Where ΔYt is a first-order difference, Yt-1 is a vector of price time series, 'Γ' and 'Π' denote the matrices of parameters, p is the number of lags, □t is an error term. The trace test and maximum eigenvalue test were used to identify the number of co-integrating vectors via the following equations:

$$J_{trace} = -T \sum_{i=r+1}^{n} \ln(1 - \lambda_i)$$

$$J_{\max} = -T \ln(1 - \lambda_R + 1)$$

Granger Causality Test

Finally, to assess the direction of price transmission among the markets, the Granger causality test (Granger, 1980) was employed. This method allowed for the identification of causal relationships between the price movements in the selected markets, providing insights into how price changes in one market might influence others. Granger causation between the prices of two markets is reported as follows:

$$\Delta h\ X_t = \sum_{i=1}^{m} \alpha_i \Delta h\ X_{t-1} + \sum_{j=1}^{m} \beta_j \Delta h\ Y_{t-j} + \varepsilon_{1t}$$

$$\Delta h\ Y_t = \sum_{i=1}^{m} \alpha_i \Delta h\ Y_{t-1} + \sum_{j=1}^{m} \beta_j \Delta h\ X_{t-j} + \varepsilon_{2t}$$

Where, X and Y represent two distinct market price series, while their logarithmic transformations are denoted as ln. The null hypothesis in both equations asserts that there is no Granger causality between the variables. Rejecting the null hypothesis suggests the existence of Granger causality between the markets. This stepwise approach enabled a comprehensive analysis of price dynamics and market linkages, ensuring robust results that are crucial for understanding the interdependencies between the selected markets.

Result and Discussion

Price Dynamics of Ashwagandha

For comparison of the nature of the Ashwagandha price across the selected markets (Neemuch, Shivpuri, Dhamtari, Kolkata, and Mumbai), descriptive statistics have been presented in the Table 1. During the study period, minimum prices ranged from Rs.150/Kg in Dhamtari to Rs.200/Kg in Kolkata, with Mumbai recording the highest maximum price of Rs.300, compared to Rs.250 in Dhamtari and Shivpuri. The mean prices indicate that Kolkata has the highest average price at Rs.256.19/Kg, while Dhamtari is the lowest at Rs.200.51/Kg. The coefficient of variation (CV), a measure of relative variability, is highest in Mumbai (24.44 per cent), followed by Shivpuri (15.63 per cent), and lowest in Kolkata (9.84 per cent), indicating greater price consistency in the latter. Skewness values suggest that price distributions are slightly positively skewed in markets like Dhamtari,

Table 1: Descriptive Statistics of Ashwagandha Price Across Select Markets

Variable	Neemuch	Shivpuri	Dhamtari	Kolkata	Mumbai
Minimum	190	155	150	200	150
Maximum	290	285	250	290	300
Mean	229.72	212.75	200.51	256.19	224.67
SD	28.35	33.25	26.57	25.20	54.90
CV	12.34	15.63	13.25	9.84	24.44
Skewness	0.71	0.17	0.19	-0.17	0.04
Kurtosis	-0.75	-0.90	-1.26	-1.17	-1.87

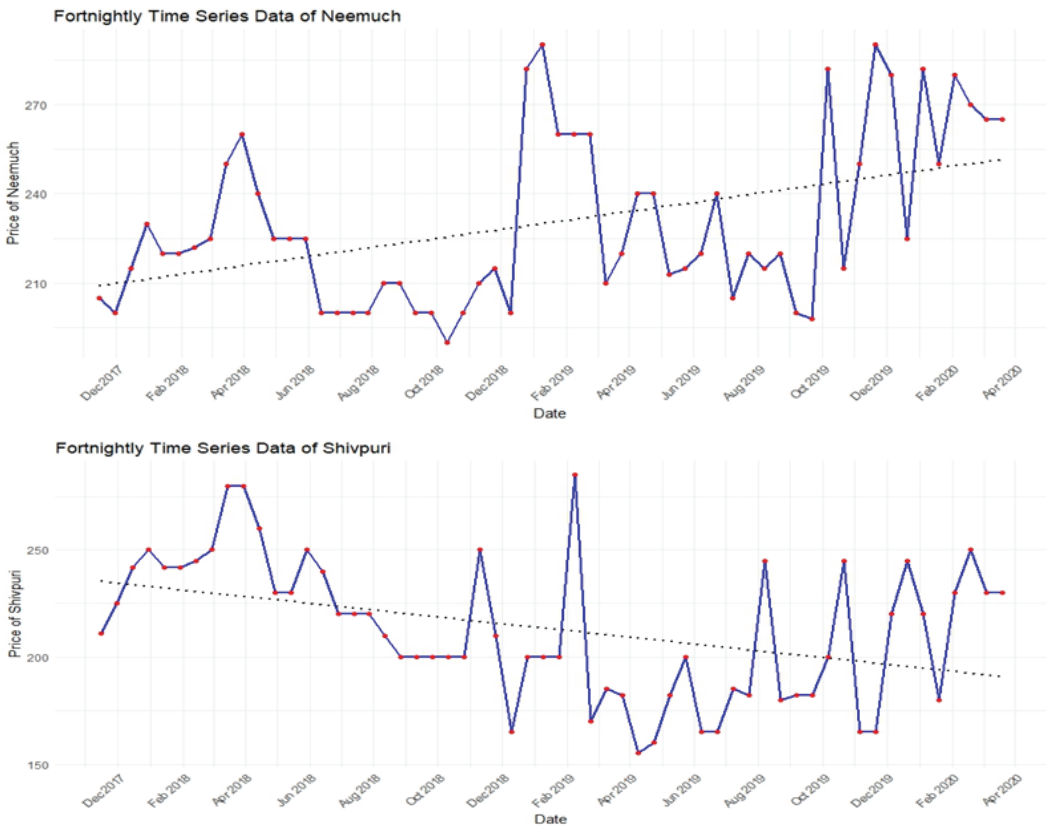
Source: Authors own compilation.

Note: SD standard deviation, CV- Coefficient of variation.

Shivpuri, and Mumbai, while Kolkatta and Neemuch exhibit mild negative skewness, implying a concentration of lower-priced Ashwagandha in these markets. Kurtosis values across all markets are negative, indicating distributions that are relatively flat compared to a normal distribution.

The price trends over the study period were examined using graphical representation (Figure 1). The trend line shows that except for Neemuch, prices of Ashwagandha in all select markets have reported a declining trend over the period. The Neemuch market experienced a rising price trend, accompanied by a distinct seasonal pattern. Prices began to rise in November and December, peaking in March, followed by a decline that continued until December. This also indicates significant fluctuations and seasonality in the market. A similar pattern was observed in the Kolkata market, where prices were highest from January to March and lowest in November and December. For the period from March to October 2019, prices remained relatively stable at Rs. 230/Kg. The graph also reflects the coefficient of variation (CV) values shown in the accompanying table. The highest average prices were observed in Kolkata, possibly because the produce supplied to this market comes from Neemuch. The Mumbai market exhibited the highest price variability, with a CV of 24.44 per cent, indicating substantial price fluctuations. Between December 2018 and October 2019, prices in Mumbai

Figure 1: Panel of Time Series Plot of Prices of Ashwagandha in Select Market



Source: Authors own compilation.

remained relatively stable at Rs. 170 per kilogram. Similarly, the Shivpuri market displayed more price volatility, with the second-highest coefficient of variation (CV = 15.63), suggesting moderate price fluctuations during the study period. It can be concluded that harvesting time coincides with the higher prices as the harvesting period is January-March, and prices in markets like Neemuch and

Kolkata remain on the higher side during February-March.

Unit Root Test

The unit root test is an empirical method used to assess the stationarity of a stochastic process. It is essential to examine the stationarity of a time series before proceeding with co-integration analysis, as regression on non-stationary time series can lead to spurious results (Saha et al., 2019). In this analysis, the Augmented Dickey-Fuller (ADF) test was applied to check for stationarity, with the results summarised in Table 2. The null hypothesis for the ADF test is the "series is non-stationary" (Vasanthi et al., 2014). It was observed that the price series of all the selected markets were non-stationary at the level, but after differencing the original series at lag one, all the series became stationary. This indicates that the price series of Ashwagandha in the selected markets are stationary at the first difference, meaning all the series are integrated in the same order and are suitable for co-integration analysis.

Table 2: ADF Unit Root Test

Markets	Level	P value	Remark	First difference	p-value	Remark
Neemuch	-2.247	0.475	Non-stationary	-3.591	0.042	Stationary
Shivpuri	-1.690	0.700	Non-stationary	-7.092	0.010	Stationary
Dhamtari	-1.997	0.576	Non-stationary	-4.658	0.010	Stationary
Kolkata	-1.887	0.620	Non-stationary	-5.449	0.010	Stationary
Mumbai	-0.598	0.974	Non-stationary	-3.521	0.048	Stationary

Source: Authors own compilation.

Market Co-integration

Johansen (1988) developed a multivariate co-integration approach, a robust method for testing the long-run equilibrium

Table 3: Estimation of Johnson Co-integration Test

Hypothesis	Trace test		Eigen value test	
	Statistics	Critical value at 5 per cent	Statistics	Critical value at 5 per cent
at most 4	4.04^{ns}	9.24	4.04	9.24
at most 3	22.38*	19.96	18.34*	15.67
at most 2	46.43*	34.91	24.05*	22.00
at most 1	87.26*	53.12	40.83*	28.14
None	138.91*	76.07	51.66*	34.40

Source: Authors own compilation.

Note: * denotes the significant at 5 per cent level. ns non-significance

Table 4: Estimation of Pair-Wise Johnson Co-integration Test

Market pair	Null Hypothesis	Trace statistics
Dhamtari - Kolkatta	r=0	25.51*
	r ≤1	10.87 ns
Dhamtari - Neemuch	r=0	25.51*
	r ≤1	10.87
Dhamtari - Shivpuri	r=0	21.92*
	r ≤1	8.89 ns
Dhamtari - Mumbai	r=0	20.16*
	r ≤1	3.81 ns
Kolkatta - Neemuch	r=0	20.16*
	r ≤1	3.81 ns
Kolkatta - Shivpuri	r=0	26.84*
	r ≤1	8.40 ns
Kolkatta - Mumbai	r=0	22.34*
	r ≤1	6.74 ns
Neemuch - Shivpuri	r=0	26.84*
	r ≤1	8.40 ns
Neemuch - Mumbai	r=0	22.34*
	r ≤1	6.74 ns
Shivpuri - Mumbai	r=0	27.97*
	r ≤1	5.68 ns

Source: Authors own compilation.

Note: critical value at 5 per cent level of significance for r=0 and r≤1 are 19.36 and 9.24, respectively. ns non-significance.

relationships between stationary price variables. In this study, the Johansen multiple co-integration test was employed. The optimal lag length for the co-integration analysis was determined using the Akaike Information Criterion (AIC). The results of the Johansen co-integration test, presented in Table 3, include both trace and maximum eigenvalue statistics. These results indicate the presence of four co-integrating equations, suggesting a long-run relationship between the variables. Specifically, at least one co-integrating equation exists, which confirms the existence of a long-run relationship among the selected markets. Furthermore, the analysis confirms that Ashwagandha prices across these markets are co-integrated in the long run. Additionally, pairwise co-integration tests (Trace test) were conducted to examine the relationship between pairs of markets. The results again demonstrated the existence of long-run relationships between all market pairs, reinforcing the earlier findings.

Thus, Johansen's co-integration test reveals that despite the geographical isolation and spatial segmentation of the selected Ashwagandha markets, they were interconnected in terms of prices. It can be inferred that all the selected markets showed the existence of a long-run relationship for Ashwagandha prices

and were effectively integrated, and the price signals would be transmitted from one market to another, ensuring market efficiency.

Granger Causality Test

The co-integration test confirms the long-run linkage between the markets, while the Granger causality approach is employed to assess the transmission of price signals between the selected markets. The Granger causality test provides valuable insights into the direction and nature of price transmission. A bidirectional causal relationship indicates that both markets influence each other's price formation, suggesting a mutual exchange of price signals. Conversely, a unidirectional causality implies that the price of one market affects the price of the other market but not the other way around.

The results of the Ashwagandha price transmission analysis among the selected markets are presented in Table 5. Upon examining the table, it is evident that a total of 10 bivariate pairs were considered. Among these, only one pair—Kolkatta-Shivpuri exhibited bidirectional causality, signifying a mutual price transmission between these two markets. This implies that price movements in both markets contribute to the price formation in each other. Given that Shivpuri is primarily a production market and Kolkata is a major urban market, this bidirectional

Table 5: Ashwagandha Price Transmission Between Select Markets

Null Hypothesis	F Calculated	P value	Remark
Dhamtari does not cause Kolkatta	0.528^{ns}	0.807	Unidirectional
Kolkatta does not cause Dhamatari	4.913^{a}	0.001	
Dhamtari does not cause Neemuch	1.256^{ns}	0.299	Unidirectional
Neemuch does not cause Dhamtari	2.501^{b}	0.034	
Dhamtari does not cause Shivpuri	0.860^{ns}	0.547	No Causation
Shivpuri does not cause Dhamtari	0.560^{ns}	0.783	
Dhamtari does not cause Mumbai	2.208^{b}	0.047	Unidirectional
Mumbai does not cause Dhamtari	1.584^{ns}	0.173	
Kolkatta does not cause Neemuch	1.492^{ns}	0.202	No Causation
Neemuch does not cause Kolkatta	1.170^{ns}	0.345	

continue...

continue...

Kolkatta does not cause Shivpuri	2.731[b]	0.023	bidirectional
Shivpuri does not cause Kolkatta	2.661[b]	0.026	
Kolkatta does not cause Mumbai	3.616[a]	0.005	Unidirectional
Mumbai does not cause Kolkatta	1.077[ns]	0.399	
Neemuch does not cause Shivpuri	0.809[ns]	0.586	No Causation
Shivpuri does not cause Neemuch	1.068[ns]	0.404	
Neemuch does not cause Mumbai	0.694[ns]	0.677	No Causation
Mumbai does not cause Neemuch	1.005[ns]	0.444	
Shivpuri does not cause Mumbai	0.620[ns]	0.736	Unidirectional
Mumbai does not cause shivpuri	2.020[b]	0.040	

Source: Authors own compilation.

Note: 'a' and 'b' denote significance levels at 1 per cent and 5 per cent respectively. ns non-significance.

relationship suggests that Shivpuri could be a key source market for Kolkata. In contrast, five pairs demonstrated unidirectional causality, indicating that price signals from one market influence the price dynamics of the other, but not reciprocally. These unidirectional relationships were observed in the following market pairs: Kolkata-Dhamtari, Dhamtari-Neemuch, Dhamtari-Mumbai, Kolkata-Mumbai, and Shivpuri-Mumbai. In each case, the price movements in the former market were found to significantly influence the price in the latter market, without any reverse causality. Finally, four pairs did not show any significant causal relationship, whether unidirectional or bidirectional, indicating the absence of meaningful price transmission between these market pairs. Major hubs like Kolkata appear to influence other markets, reflecting their significance in the Ashwagandha supply chain. The significant market Neemuch fund has a huge impact on price formation in the Dhamtari market in a unidirectional way. Granger causality test reveals that only a few market pairs exhibit a significant causal relationship in price formation. Price fluctuations in one market have influenced price movements in other markets, but this transmission is not observed universally across all market pairs.

Conclusion

It can be concluded from the above discussion that all the markets except Neemuch have exhibited a declining trend in prices over the study period. However, except Kolkata, all other four markets reflected higher price variation; this could be attributed to seasonal arrivals and increasing demand. The co-integration analysis revealed that select markets of Ashwagandha have shown the existence of long-run market linkage; the Granger causality test reveals that only a few market pairs exhibit a significant causal relationship in price formation. This limited price transmission suggests inefficiencies in market structures caused by factors like weak market information systems, inadequate infrastructure and outdated trading practices. Such issues lead to poor dissemination of price signals, weakening the overall market efficiency for Ashwagandha in India. To address these challenges, targeted strategies are needed. These include establishing robust market intelligence systems, especially on arrivals and prices, minimising post-harvest losses, and enhancing infrastructure such as storage and transportation facilities. These measures can strengthen market functioning and improve price signal transmission, ensuring a more efficient trading environment for Ashwagandha.

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Genome to Om: Evolving Journey of Modern Science to Meta-science

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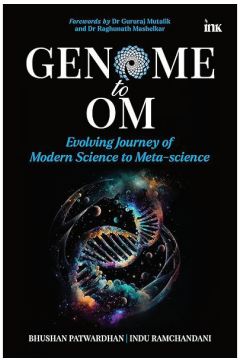

Unnikrishnan Payyappalli*


Unnikrishnan Payyappalli

Amongst some more than 25 advance praises for the book by eminent personalities, Professor Kasturirangan, Former Chairman of ISRO, offers a compelling and critical note on the title – *"A thought-provoking exploration of the frontiers where science meets spirituality. Genome to Om challenges our assumptions and pushes the boundaries of knowledge. (This is) a must-read for anyone curious about the future of scientific inquiry. The nine chapters link the reality of the world we live in and the challenges we face, as represented by Genome, which can only be resolved by realizing the true identity, with Om. The authors introduce an interesting concept of the Omcene, the future epoch, with the utopian but feasible goal of a global meta-society focused on universal well-being, finding unity in diversity."* – This simply captures the essence of the book titled 'Genome to Om' authored by Prof. Bhushan Patwardhan and Ms. Indu Ramchandani.

In an enchanting preface Prof. Bhushan Patwardhan talks about this work as a personal journey and reflections over two decades, to be precise from a Buddha Purnima day in 2003. This long journey of rumination, exchanges and its evolution through the years is simply and amply evident in the breadth and depth of knowledge and perspectives that the book covers. The whole project was seeded when Prof. Patwardhan started the work on Ayurgenomics (a path breaking early research

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in the field of Ayurveda-biology as we know it today) to identify the Ayurveda approach of personalized medicine based on "prakriti" (individual constitution) and its genetic correspondences as in modern biology. Around this time the human genome project was also in the horizon. He derived motivation from the profound and widely celebrated verse of the Esavasya Upanishad, shanti mantra– "*Om purnamada purnamidam purnat purnamudachyate purnasya purnamadaya purnameva avashishyate*" meaning this is complete and that is complete and if you remove a portion from the complete the removed portion is complete and what remains is also complete – he visualizes this sutra as an amazing correlation to the genome!

The book was initially titled as 'Om to Genome' but after several reflections resulted in an inversion to mean that the Genome (representing modern science) has much to learn from Om (representing ancient knowledge systems). The terms Genome and Om have been used metaphorically to capture multiple themes and meanings throughout the book.

Mrs. Indu Ramchandani in her preface narrates her long career as the South Asia Editor-in-Chief of the Encyclopedia Britannica as well as her extensive reading of the upanishads with Pravrajika Vivekaprana ji. These led to her deep interest in building bridge between science and spirituality which immensely helped in shaping the book. The magical combination of the authorship and their deep inward journeys in respective careers are perceptible throughout the work in the precise selection of contents, their logical structuring and the mesmerizing narration.

With a detailed prologue, followed by nine chapters braided in a systematic, captivating rendition the authors take the reader through the wonderland of universe, knowledge and life. The prologue outlines the scope of the book; innovations and perils of modern scientific enterprise; the depth of the vedas, upanishads, darshanas and sastras and the diverse Eastern mystic traditions; and finally, what the authors call the evolutionary journey of modern science to 'meta-science' i.e. 'the science of science'. The book is full of insightful aphorisms and their nexus with 'meta-science' – '*Prajnanam Brahma*' from Thaithareeya Upanishad describes three levels of internalization of knowledge as jnana, vijnana and prajnana. These could be roughly translated into information, knowledge and wisdom respectively – this prajnana is described in the book as meta-science. The authors make distinction between anubhava (experience that can be measured) and anubhooti (an experience of the inner self, which is tacit, cannot be communicated in words). Citing the words of stalwarts like Albert Einstein, Carl Friedrich Gauss (German mathematician and astronomer), Srinivasan Ramanujan and contemporary physicists like Brian Josephson, authors highlight the importance of intuition (as anubhooti) in advancing knowledge beyond empiricism. Science is the study about nature whereas meta-science is the internalization of the 'nature of nature' and its study. Furthermore, by bringing the idea of *loka - purusa* of the Ayurveda School, i.e. the interconnectedness of microcosm (individual) and macrocosm (universal), authors argue that there is the universal consciousness which connects everything in the universe. "*The unity at both the macrocosmic and microcosmic levels lies in the one consciousness that pervades*

everything. Metaphorically, we represent it as Om." The authors also propose the obligation of meta-science towards building a meta-society – science leading to *Sarva jana sukhaya sarva jana hitaya cha* - "for the happiness of all, for the welfare of all."

Interestingly in the first chapter titled "Genome: The evolution and marvels of science and technology', the authors capture the historical trajectory of development of knowledge over millennia of human civilization. The chapter starts with the early civilizations to the cutting edge technologies and frontiers of science and technology of our times – a scenic journey literally through the Stone Age of 3.4 million years to the Common Era to the anthropocene. A beautiful infographic portrays the chronology of world civilizations starting from Sindhu Sarasvati through Mesopotamian to Egyptian to Chinese among several others as well as the European renaissance and scientific revolution. Perceptively the authors also share a caution on the Sindhu Sarasvati, Indus valley-Harappan civilizations and the ongoing debates around their chronology. The chapter also gives an extensive account of the European renaissance, various scientific and social revolutions, through the world wars to the 21st century scientific innovations in diverse areas like biotechnology, omics, to astronomy to AI & ML to robotics/ nanobots among several others.

The authors excitedly state that after having evolved over millions of years "*the genome emerges as a remarkable emblem of the conscious microcosm*" in the web of life – "*transcends its physical entity to embody attributes of consciousness, universality, immortality, and completeness.*" With an extended section on Ayurveda principles the chapter also outlines the link between prakriti as a framework, genetics as a lens (to study inherited features) and epigenetics as linked to samskara (as the striking interplay between nature and nurture) for comprehending life forms and personalities. The book argues that there are several knowledge points from our ancient knowledge systems or even mythology across civilizations and regions which if properly researched will form the basis for futuristic science and technology. They also add "*Yesteryears' science fiction has become today's reality, thus scientists have to keep an open mind to exploration.*"

The subsequent chapter beautifully captures the perils of our anthropocene - a comprehensive summary of the discussions around planetary boundaries, our exploitation of the mother earth and various drivers and determinants of the accelerating sustainability challenges. Though science has evolved and transformed so much over centuries, today by and large science is used for satisfying the greed of individuals or institutions or countries and for making profits, we are moving so far away from the purpose of doing good to the humanity. The chapter highlights several examples of such disruption and violence and is a clear call for introspection and change in the current trajectory to a humane path. One is left to wonder how the authors have so subtly captured all those dialectics from the time of the Club of Rome to the latest discussions on climate justice.

The next chapter deals with 'The origin of the cosmos and life' in which the worldviews of various civilizations of the universe and life; as well as various contemporary scientific theories; their unresolved and contested areas are

extensively discussed. Authors mention "*these unresolved problems ignite curiosity, inspire further research, and push scientists and those of us who are invested in 'knowing'", to refine and expand our understanding. This is the "evolving journey of modern science to meta-science"*. They also add "*it is important, however, to distinguish between faith and blind faith. It is the difference between having the freedom to question and explore within a belief system versus an unquestioning acceptance of ideas without evidence or analysis."*

In an entrancing follow up chapter the authors ask the question what is life and what are life's biological, social and spiritual dimensions. What should clearly surprise a reader is the ease with which various disciplinary dimensions (biological, social as well as spiritual) spanning across diverse traditional knowledge streams and contemporary sciences are deliberated in the text. By bringing examples of viruses, dormant seeds and intriguing proteins like prions, the authors critically reflect on 'life at the margins' and the challenges in the conventional parameters to define living and non-living forms. "*Emergence is a phenomenon where complex systems show properties or behaviours that cannot be explained by simply understanding the individual parts in isolation. Emergent properties require a holistic approach that considers the interactions and dynamics between various components."* Citing instances from system biology and neurosciences authors here share the dilemma of the part and the whole in knowing.

The chapter which follows asks the question what is the mind? It is a fairy voyage on various biological and philosophical subtleties of transcending from thinking to knowing. What would be of special interest here for an Ayurveda learner is the eclectic discussion on the connection between food and mind besides the extensive discussion on mind, consciousness and healing powers within in the darshanas and upanishads as well as their corresponding modern scientific advances. Citing conversations with Prof. Brian David Josephson, a Welsh physicist and Nobel laureate from the University of Cambridge who took up transcendental meditation and turned his attention to issues outside the boundaries of mainstream science, worked on the famous Mind - Matter unification project, the first author opines that there is so much unknown in the universe which are potential sources of innovation that the leaders of science have shown to us. Towards this chapter with the vastness of the subjects and the analyses covered the text becomes a bit overwhelming!

Covering questions on the universe, our planet, life in a retrograde order, the next chapter goes on to ask, 'Who am I?' The chapter deeply engages on issues of identity followed by two chapters one on the 'purpose of human existence' and the other on 'death and beyond'. Authors say *"Om" represents interconnectedness, a super-cosmic consciousness with limitless potential. We can cultivate focus, self-awareness, and inner peace – tools that not only propel our personal growth but also allow us to tap into this vaster consciousness, giving a new dimension to purpose and goal.* Om according to the authors is just an exemplar – *"various spiritual traditions offer practices that can complement our diverse pursuits of a meaningful life. The essence is that reaching our full potential is not just about external achievements but also about inner growth and a sense of connection to something larger than ourselves. As we strive to become the best*

versions of ourselves, we leave a legacy that inspires generations to come, a testament to the potential that resides within each of us."

The final chapter gives a broad roadmap for the journey from the Anthropocene to Omcene, meta-science to meta-society – "*a path towards a more harmonious existence beckons – a world built on the cornerstones of compassion, simplicity, and universal wellbeing*". They describe this as the path of 'Omway' leading to the optimum potential of an individual (Omstate) to actualizing a harmonius civilization (Omscene)!

The book closes on a positive note, by calling the leadership to take action towards building interconnectedness and harmony by embracing insights from various world cultures and civilizations of the past. While Yual Noha Harari in his book titled 'Homo Deus- a brief history of tomorrow,' predicts a shift of homo sapiens to homo deus (as individuals with super human abilities and eternality), the authors cautiously call for a finer transformation into homo spirituals!

Susruta Samhita says "*Ekam shastram adhiyano na vidyat shastra nischitam, tasmat bahushrutam shastram vijayniyat chikitsaka*" - For an Ayurveda learner the book unambiguously informs the essence of this proverbial verse. With the meta-analyses of 'nearly everything' (to borrow from the acclaimed author Bill Bryson) that is under the sun and beyond millions and billions of galaxies the book really opens innumerable perspectives in building bridges between multiple knowledge systems while also going deeper into the insights within (Sva-anubhooti). In a pragmatic way, the book also informs the relevance of Ayurveda and other traditional knowledge systems in addressing the contemporary challenges and offers definite transdisciplinary perspectives. This evidently makes it a must read for an Ayurveda or integrative health practitioner.

Professor Raghunath Mashelkar in his foreword to the book writes "*What I liked especially is the fact that the authors are balanced in their outlook, not veering into rhetoric or religiosity.*"- the authors have successfully negotiated through the relativist and ethnocentric tendencies throughout the text while dealing with traditional wisdom and the reductionist sciences – in one of the chapters while talking about meta-science the authors boldly say "*meta-science goes beyond the boundaries of empiricism and logical reasoning. It stands on the spirit of Karl Popper's concept of falsifiability*"! – the book genuinely reveals the openness and the spirit of this transformative endeavour.

The book has an encompassing glossary of vedic terms discussed in the text, highly helpful for an uninitiated reader. It also has a detailed bibliography of books, scientific papers, reports, and relevant websites, as well as a comprehensive index all organized in a well-structured manner. Unlike the usual titles the text lacks annotations in footnotes or references which is understandable considering the enormity of the work.

In his foreword Prof. Giriraj Mutalik, a highly eminent physician scientist, shares his riveting wisdom which I cannot resist sharing (entirely) here - "*Each of us holds within us the power to ignite change. While institutions may falter, an individual spark of conscience and courage can inspire a monumental movement. We must amplify these sparks, empowering grassroots initiatives, transforming education, and fostering a new*

narrative that celebrates cooperation, empathy, and our connection to nature. The challenges we face are not merely technological or economic; they are deeply spiritual. True spirituality is not about dogma or ritual but a lived experience of interconnectedness, compassion, and service to others, recognizing the spark of the divine in every living being and acting accordingly. Each breath, each action, becomes an opportunity to cultivate kindness, wisdom, and reverence for all life. By embracing our spiritual nature, we tap into a wellspring of resilience, creativity, and collective power that can guide us through this perilous crossroads."

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