



Review Article

A NARRATIVE REVIEW ON *PRAKRITI*/AYURGENOMICS: THE SCIENTIFIC ELABORATION OF
AYURVEDA CONCEPTS AND WESTERN GENETICS

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Article info

Article History:

Received: 20-05-2026

Accepted: 14-06-2026

Published: 19-07-2026

KEYWORDS:

Ayurgenomics,
Ayurveda, Genomics,
P4 Medicine,
Personalized
medicine,
Pharmacogenomics,
Prakriti.

ABSTRACT

The concept of *Prakriti* (the psycho-somatic constitution of each person) is an ancient clinical phenotyping system based on distinct anatomical, physiological, and metabolic constitutions and Ayurveda has used it as the foundation for personalized healthcare. Ayurgenomics is an emerging interdisciplinary field that bridges Ayurveda's *Prakriti* classification with modern genomics, molecular biology, and omics technologies, positioning it as a key contributor to P4 Medicine (predictive, preventive, personalized, and participatory medicine). **Objective:** This narrative review synthesizes current evidence on the genetic, metabolic, immunological, microbiomics, and epigenetic correlates of *Prakriti* phenotypes. The primary aim is to evaluate the scientific basis of Ayurgenomics, explore its translational implications for P4 Medicine, and identify challenges and future directions. **Methods:** A comprehensive literature search was conducted across electronic databases (PubMed/MEDLINE, Scopus, Google Scholar) and classical Ayurvedic texts. Peer-reviewed original research and reviews reporting genomic, biochemical, immunological, or microbiomics findings stratified by *Prakriti* type were selected and structurally synthesized. **Results:** The current multi-omics data reveal a set of molecular and genetic markers associated with metabolism, the microbiome, immunity, and disease susceptibility that correspond to distinct *Prakriti* phenotypes described in classical Ayurvedic texts. **Conclusion:** The evidence to date demonstrates a compelling genetic foundation for *Prakriti* and supports Ayurgenomics as a transformative framework for integrating ancient wisdom with cutting-edge science toward an individualized and effective global healthcare system.

INTRODUCTION

As Voltaire has critiqued, "Doctors put drugs of which they know little, into bodies of which they know less, for diseases of which they know nothing at all."

This quote accurately encapsulates the current challenges faced by modern medicine: rising non-communicable diseases, differing patient responses to therapies, and the escalating incidence of adverse drug reactions can all be traced back to a generalized approach. Although there has been notable progress in genomics and molecular biology, the complex differences among individuals are still largely

overlooked, resulting in treatments that either fail or are detrimental to certain patients. Therefore, there is a pressing need for personalized healthcare.

Interestingly, Ayurveda, the ancient system of medicine, recognizes the unique differences among humans and classifies them based on their psycho-somatic constitution, called *Prakriti*, which forms the foundation of personalized healthcare.

Despite numerous attempts, there is currently no effective method for categorizing human populations for health- or disease-related purposes. As a result, the idea of *Prakriti* has attracted the interest of contemporary scientists as a means to classify individuals based on both phenotypic and genotypic differences. This is precisely where the emerging field of Ayurgenomics offers a revolutionary solution: validating the concept of *Prakriti* by identifying genetic markers that explain individual variability, thereby facilitating personalized medicine.

Access this article online	
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	https://doi.org/10.47070/ijapr.v14i7.4250
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Understanding *Prakriti* in Ayurveda

Prakriti gives every individual distinct anatomical, physiological, and psychological trait that govern their physique, skin, personality, sensory perception, and metabolism. *Prakriti* is determined by the dominance of *Dosha* in the sperm and ovum during their union. Hence, the proportions of *Doshas* are determined genetically at the embryological stage and remain inherent in the individual from birth to death.

"It is far more important to know what person the disease has than what disease the person has." These words of Hippocrates rightly resonate with the Ayurvedic principle of *Dashavidha pariksha*, in which *prakriti* is the first step in examining a diseased person.

Prakriti assessment in healthy individuals aids in predicting disease risk across different ages, climates, and regions, and in designing dietary and lifestyle regimens accordingly. While in disease, it determines severity, prognosis, likely complications, recurrence, and response to treatment. Thus, serving both the objectives of Ayurveda of '*Swasthasya-swastha rakshanam aturasaya-vikara prashamanam*'.

Foundation of Western Genetics

Genetics plays a considerable role in all diseases. Genomics has revolutionized the understanding of disease mechanisms by identifying genetic variations and mutations. Variations in the genome sequence that lead to genotypic changes, called Single Nucleotide Polymorphisms (SNPs), are responsible for phenotypic variation. Every person has a unique sequence of 3 billion nucleotides, making it extremely difficult to identify significant differences among this vast pool of genetic variations.

The rising incidences of Adverse Drug Reactions have prompted many advanced genetic studies revealing that medicine cannot be driven by the idea of 'one size fits all.' This led to the advent of pharmacogenomics, the application of genomic technologies to drug development based on a person's genetic makeup, with a known expected drug response, thereby reducing the risk of ADRs and drug overdose and maximizing therapeutic efficacy.

Bridging the Gap: The Emergence of Ayurgenomics

In the absence of a tailored approach in contemporary medicine, Ayurgenomics defines *Prakriti* in the language of genetics and molecular biology. Ayurgenomics is a novel approach in P4 Medicine (predictive, preventive, personalized, and participatory medicine) that aims to identify genetic markers associated with *Prakriti* types and their predisposition to disease. Ayurgenomics appears to draw on the concept of pharmacogenomics, but from Ayurveda's perspective, it is not only for personalized

medicine but also for disease control and improved quality of life for healthy people.

The fundamentals of *Prakriti* have been known for ages, but without scientific validation, they have not been recognized globally. A decade ago, efforts were initiated to connect *Prakriti* with genomics. CSIR-IGIB conducted the first Ayurgenomic research study in an Indo-Russian population, garnering significant international interest. Since then, numerous studies have used modern omics technologies to investigate the genetic foundations of *Prakriti*.

Rationale for This Review

Although several primary research studies have examined specific genetic or molecular correlates of *prakriti*, a comprehensive narrative review that maps the full picture of Ayurgenomic evidence spanning genomics, pharmacogenomics, immunology, microbiomics, and epigenetics, and articulates its clinical and research implications, remains lacking. Given the rapid global shift toward P4 Medicine, this review addresses that gap by consolidating the evidence base, identifying consistent findings and knowledge gaps, and proposing future directions for both researchers and clinicians.

OBJECTIVES

This manuscript aims to describe the relevance of *Prakriti* to contemporary genomics, synthesize published evidence on the genomic correlates of the three primary *Prakriti* types (*Vata*, *Pitta*, and *Kapha*), and examine the scientific basis of Ayurgenomics as a discipline that bridges Ayurveda and modern molecular biology. We also aim to explore the implications of Ayurgenomics for personalized and precision therapeutics in public health, and to identify current challenges and future research directions in the field.

MATERIALS AND METHODS

Study design

This manuscript is a narrative review and conceptual analysis that synthesizes and interprets a broad, evolving field of Ayurgenomics spanning Ayurveda, genomics, pharmacogenomics, immunology, microbiomics, and epigenetics.

Literature Search Strategy

A comprehensive, organized literature search was conducted across multiple electronic databases, including PubMed/MEDLINE, Google Scholar, Scopus, ResearchGate, AYUSH Research Portal, Charak Samhita Online New Edition (CSRTSDC, 2020), and classical Ayurvedic texts (*Charaka Samhita*, *Sushruta Samhita*, and *Ashtang Hridaya*).

RESULTS

Selection and Synthesis

The selection process was designed to record conceptual and empirical information from both Ayurvedic and biomedical sources for structured compilation. Studies were selected based on relevance to the objectives of this review.

Table 1: Inclusion and Exclusion Criteria for Study Selection

Inclusion criteria	Exclusion criteria
Peer-reviewed original research articles and reviews.	Abstracts without full-text availability.
Classical Ayurvedic texts	Studies not reporting <i>prakriti</i> classification methodology.
Modern studies reporting genomic, biochemical, immunological, or microbiomics findings stratified by <i>Prakriti</i> type.	Theoretical studies and studies with insufficient genomics data.

Evidence was narratively summarized and grouped into these main areas: (i) genetic basis of *Prakriti*; (ii) metabolism and pharmacogenomics; (iii) immunity and disease susceptibility; (iv) gut microbiome and health; and (v) epigenetic influences.

Genetic Basis of *Prakriti*

52 significant SNPs associated with *Prakriti* were identified, strongly suggesting a genetic foundation for *Prakriti*¹. Extreme *Prakriti* groups (*eka-doshaja prakriti*) have revealed SNPs associated with these groups and various diseases:

1. The IFIT5 gene and its variant, crucial for boosting the immune response during viral infections, are associated with reduced expression in *Pitta* individuals relative to *Kapha*, confirming that *Kapha prakriti* possesses greater immune strength (*Ojasvina & Mahabala*).
2. Another variant of the SERPINA10 gene, which regulates blood clotting, is more frequently observed in *Pitta prakriti*, suggesting a tendency for bleeding disorders.
3. Certain SNPs are linked to various health risks in different groups, such as cirrhosis in the *Pitta* group and obesity traits in the *Kapha* group.
4. The HLADRB1*13 gene variant, which protects against dementia and autoimmune diseases, is low in *Vata* individuals, indicating a higher risk for these conditions.^[1]
5. Certain genetic risk factors show higher prevalence in specific *Prakriti* groups, aligning with their described characteristics, like proportional body measurements (*Samhata-sthira-sarirāḥ*) with the

Kapha group, while hemoglobin levels are higher in the *Pitta* group (*Tāmra-nakha-nayana-tālu-jihvaustha-pāṇi-pāda-talo*), delayed aging in *Kapha prakriti* (*Āyushmanṭa*) and early aging in *Pitta* (*Madhyāyusḥo*) and *Vata* individuals (*Alpāyusḥa*) due to high BMR.^[2]

Metabolism and Pharmacogenomics

Genetic variations related to fat metabolism are observed in *Kapha* individuals, while thermogenesis-related genes show differences in *Pitta* individuals.

There is a link between the CYP2C19 gene polymorphism and *Prakriti*, indicating genetic influence on metabolic rate. *Pitta* individuals exhibit rapid metabolism (*Tikshna-agni*), while *Kapha* individuals show a greater prevalence of poor-metabolizer genotypes (*Mandagni*), and *Vata* types show variable metabolism (*Vishamagni*).^[3]

Immunity and Disease Susceptibility

1. CD14-marker was expressed highly in *Pitta prakriti*, indicating a hyperactive immune response, which makes them more susceptible to autoimmune diseases. In contrast, higher expression of CD25 & CD56 was observed in *Kapha prakriti*, suggesting a stable immune response. Lower expression of CD markers in *Vata prakriti* indicates diminished immune response.^[4]
2. Genetic markers linked to disease susceptibility are enriched in certain *Prakriti* groups, such as *Kapha* with metabolic disorders, *Pitta* with inflammatory conditions, and *Vata* with degenerative diseases.^[5]
3. Heart rate variability during head-up tilt reveals that *Kapha prakriti* has minimal fluctuations in HRV, whereas *Vata* individuals experience a more significant decrease in parasympathetic activity. This suggests that *Vata* individuals are more prone to autonomic dysfunction.^[6]

Gut Microbiome and Health

Among genetically similar individuals, small but significant differences in gut microbiomes could be explained by their *Prakriti*^[7]:

1. *Pitta* individuals exhibit increased levels of good bacteria (*Blautia* species), important for digestion and GIT disease prevention. Also, the presence of butyrate-producing bacteria collectively indicates their contribution to gut homeostasis and defense against inflammation.
2. *Vata* individuals possess a combination of microorganisms associated with insulin resistance and infections, along with beneficial butyrate-producing bacteria, highlighting the complex balance within the gut microbiome of *Vata prakriti* (*Vishamagni*).

3. *Vata* individuals possess a gut microbe, *Paraprevotella*, which contributes to lowering BMI and fat levels.
4. *Kapha Prakriti* tends to face health issues like obesity, type-2 diabetes, and atherosclerosis due to elevated levels of gut bacteria like *Prevotella*.

Epigenetic Influences

DNA methylation is an epigenetic process that can modulate gene expression. These alterations can occur during life stages such as pregnancy and development and are influenced by factors such as the mother's diet, stress, and the timing and season of conception, leading to lifelong effects on traits like birth weight and BMI.

This concept of epigenetics closely aligns with the factors influencing the *Prakriti* of the fetus mentioned by Charaka:

*Tadyathā- Śukraśonitaprakṛtiṃ,
Kālagarbhāśayaprakṛtiṃ, Māturāhāravihāraprakṛtiṃ,
Mahābhūtavikāraprakṛtiṃ ca garbhaśarīramapekṣate/*
(Ca. Vi. 8/95)

That the *Prakriti* of the fetus is determined by factors such as 1) sperm and ovum, 2) season and condition of the uterus, 3) food and regimens of the mother, and 4) nature of the *Mahabhutas* (foundational physical elements) comprising the fetus.

A study revealed distinct patterns of DNA methylation associated with various body types, indicating that *Kapha prakriti* are likely to have a higher BMI, whereas *Vata prakriti* generally have a lower BMI, suggesting an epigenetic impact on phenotypic characteristics.^[8]

DISCUSSION

The integration of the traditional Ayurvedic approach to phenotyping with modern omics technologies represents a significant paradigm shift in personalized healthcare. By bridging the observational science of *Prakriti* with systems biology, the above studies refute the notion that *Tridosha* theory can be observed only and establish that it can also be measured biologically. Such validation offers a practical and non-invasive way to classify patients in internal medicine. It empowers clinicians to move past a 'one-size-fits-all' approach and use targeted, phenotype-specific interventions. Together, these findings highlight the unique molecular patterns of each *Prakriti* type and support Ayurgenomics as a strong foundation for P4 medicine.

Future Directions

Ayurgenomics serves as a platform that scientifically validates Ayurvedic principles, moving beyond anecdotal evidence to evidence-based practice. As Ayurgenomics is still in its budding stage, numerous concepts of Ayurveda need to be re-validated:

1. Diet and lifestyle that vitiate the *Doshas*, similar to an individual's *Prakriti*, make the person susceptible to ailments of that *Dosha*. Serious illness can be caused if the *Dosha* is similar in *Prakriti* and *Samprapti*. Therefore, investigating the genetic factors underlying the *Nanatmaja-vikaras* (diseases due to specific vitiated *Dosha*) mentioned by Acharya Charaka (80 *Vata-vikara*, 40 *Pitta-vikara*, and 20 *Kapha-vikara*) can aid in predicting and preventing such conditions in individuals with the corresponding *Prakriti*.

*Vātalasya vātanimitāḥ, Pittalasya pittanimittāḥ,
Śleṣmalasya śleṣmanimitā vyādhayaḥ prāyeṇa
Balavantaśca bhavanti ||15|| (Ca. Vi.6/15)*

Vatala (dominance of *Vata*), *Pittala* (dominance of *Pitta*), and *Shleshmala* (dominance of *Kapha*) types of individuals are more susceptible to *Vatika*, *Paittika*, and *Shlaishmika* diseases, respectively, and such diseases in the respective types of individuals become very severe.

2. Exploring the genetic foundation of *Garbhini-paricharya* (Ayurvedic antenatal care) and *Pumsavana-karma* (rites for begetting healthy progeny) can deepen our understanding of epigenetics, thus aiding in preventing rare genetic disorders by serving as a non-invasive gene-modifying method for healthy progeny.
3. Ayurveda diagnosis and treatment of a disease rely on *Amsha-amsha kalpana* [advanced diagnostic concept in Ayurveda used for the highly detailed, fractional analysis of *Doshas* and their specific *Gunas* (qualities) during a disease process]. Specific *Prakriti* traits are described according to *Prakruta Dosha-guna* (the natural inherent qualities of the *Doshas*). Thus, evaluating *Prakriti* shows the state of *Dosha-guna*, and any abnormalities enable us to frame a *Guna/target-specific* therapy, facilitating precision medicine.
6. SNP is enough to cause a disease; similarly, a deviation in one *Guna* of *Dosha* is enough to manifest *Vikruti* (morbidity). Therefore, Ayurgenomics can verify the concept of *Dosha-guna amsha-amsha kalpana* by identifying specific SNPs associated with disease development in various *Prakriti* subtypes.
7. Classical texts mention that people residing in *Jangala-desha* (arid-hot climate) and *Anupa-desha* (wet climatic area) tend to have *Vata/pitta* dominant *Prakriti* and *Kapha/Vata* dominant *Prakriti*, respectively. Conducting a population-based study within a specific geographical region can help identify the majority of *Prakritis*, predict disease vulnerability in that population, and implement preventive strategies, ultimately improving public health and reducing healthcare budgets.

8. Ayurveda provides a variety of personalized diet and lifestyle recommendations as well as therapies for specific *Prakriti*, like *Vata-prakriti* people, who should be treated with *Snehan-swedana* (therapeutic oleation-fomentation), *Mridu-shodhana* (mild detoxification), *Madhur-amla-lavana rasa* (sweet-sour-salty taste) dominant drugs, *Abhyanga* (massage), fermented drinks (*Sura-asava*), *Snehapana* (internal oleation), and *Basti* (therapeutic enema). For *Kapha prakriti*, *Tikshna-shodhana* (strong detoxification), *Katu-tikta-kashaya* (pungent-bitter-astringent), light, dry foods, and vigorous exercise are advised. This reveals that the principles of pharmacogenomics have been followed for ages; however, Ayurgenomics can offer a scientific rationale for these concepts.

Limitations

Ayurveda proposes that *Prakriti* is shaped not only by genetic factors but also by ethnicity, geography, climate, age, and individual differences, which supports the concept of epigenetics. So, there is a challenge in establishing a link between genetic variation and the *Prakriti* classifications across ethnically diverse populations. Moreover, the major challenge is the lack of a universally standardized format for *Prakriti* assessment, which may lead to inconsistencies in scientific evidence.

To date, only *Eka-doshaja* (single-Dosha dominance) *Prakriti* traits have been identified and genetically studied. But these *Prakriti* subtypes are less prevalent than the mixed subtypes; hence, genomic studies are needed to identify these subgroups. Another obstacle is data privacy and the ethical use of genetic information. Also, to expand the scope of Ayurgenomic research, we need expensive genomic technologies and equipment, as well as specialized training for healthcare professionals.

Key Implications

The integration of Ayurveda's *Prakriti* framework with modern scientific approaches offers several opportunities for all stakeholders in the healthcare industry. For clinicians, *Prakriti*-based assessment may serve as a low-cost, non-invasive stratification tool to guide individualized preventive and therapeutic strategies alongside or prior to genomic testing. Standardization of *Prakriti* assessment tools, expansion of genomic studies to include mixed *Prakriti* subtypes, and multi-ethnic cohort studies represent the most pressing research priorities. For policymakers, integrating Ayurgenomic insights into national health programs, especially for non-communicable disease prevention among South Asian populations, warrants consideration. For the pharmaceutical industry, Ayurgenomics offers a novel framework for drug stratification and reducing

adverse drug reactions, grounded in a validated ancient classification system.

CONCLUSION

"If it were not for the great variability among individuals, medicine might as well be a science and not an art." William Osler's thoughts in 1892 align with the 5,000-year-old Ayurvedic principle of '*Purusham-purusham-veekshya*,' i.e., every person is different. In this era of giant pharma companies, skyrocketing healthcare costs, and expensive drug trials that often yield uncertain results, acknowledging the significance of personalized medicine has become essential. Ayurgenomics holds the promise of transforming healthcare by integrating the age-old wisdom of *Prakriti* with cutting-edge science. This synergistic approach promises not only to alleviate the disease burden but also to significantly enhance health outcomes and advance the global wellness industry toward a truly individualized and effective healthcare system.

Functional definitions of Ayurveda terms:

1. **Agni:** Described as the "digestive/metabolic fire". Impaired *Agni* leads to incomplete digestion and the formation of *Ama*.
2. **Ama:** Defined as "toxins" or "toxic by-products". They form as a result of impaired *Agni* (incomplete digestion) and accumulate in tissues, disrupting both systemic and mental balance. *Ama* accumulation correlates with elevated inflammatory cytokine levels.
3. **Dosha (Vata, Pitta, Kapha):** The three fundamental principles in Ayurveda. Disease is viewed as arising from an imbalance of these *Doshas*.

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Cite this article as:

Rachna Sharma, Rashmi Mutha, HML Meena. A Narrative Review on Prakriti/Ayurgenomics: The Scientific Elaboration of Ayurveda Concepts and Western Genetics. International Journal of Ayurveda and Pharma Research. 2026;14(7):148-153.

<https://doi.org/10.47070/ijapr.v14i7.4250>

Source of support: Nil, Conflict of interest: None Declared

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