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AYURGENOMICS - UNIFYING ANCIENT CONCEPTS WITH GENETIC INSIGHTS

A NARRATIVE REVIEW

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Abstract

Background: Genomics has ushered in a new era of predictive, preventive and personalized medicine. Ayurveda and similar medical systems evolved on traditional scientific principles has long emphasized a personalized approach to health and disease management. Integrating the principles of Ayurveda with advances in genomics, as Ayurgenomics holds the potential to bridge this gap and enhance personalized healthcare.

Methods: Online databases: Medline, Pubmed, Embase, AMED, CAMbase and Google Scholar were searched with key words '*Prakriti*', 'genomics', 'Ayurgenomics', 'epigenetics', 'Ayurveda', 'precision medicine', 'personalized medicine', 'integrated medicine' and 'review' separately and in combination using appropriate Boolean operators AND and OR.

Results: Original research articles selected based on keywords were screened for relevancy, redundancy, English language, full text and repetitions. There was a growing trend in incorporating newer molecular techniques in identifying *Prakriti* in publications. All relevant clinical trials were included. Findings indicate distinct genetic signatures associated with *Prakriti*. Certain SNPs including those in gene related to immunity, metabolism and inflammatory regulation have been associated with specific *Prakriti* types. Collectively, these findings substantiate the hypothesis that *Prakriti* has a genetic basis reflecting both innate constitution and disease susceptibility.

Conclusions: Genomic studies on *Prakriti* provide a scientific foundation for Ayurveda's personalized approach to health and disease. Establishing robust correlation between genes and *Prakriti* could transform healthcare by enabling tailored preventive and therapeutic strategies. Larger multi ethnic studies employing advanced omics tools are required to strengthen evidence and enhance the integration of *Prakriti* based frameworks with modern precision medicine.

Keywords: Epigenetics, Integrated medicine, *Prakriti*, Personalized medicine, Systems biology.

Background

The field of systems biology offers a diverse array of experimental and diagnostic tools that enable comprehensive exploration of complex biological systems. These tools are instrumental in unravelling the intricate mechanisms that drive dysfunctional biological pathways, which are often implicated in the onset and progression of various diseases. By analysing biological systems as integrated whole rather than isolated components, systems biology provides a more holistic understanding of how molecular, cellular, and physiological interactions contribute to health and disease. A key pillar of systems biology is the integration of high-throughput 'omics' technologies such as genomics, transcriptomics, proteomics and metabolomics with advanced computational and mathematical modelling. This integration forms the foundational basis of the discipline, allowing for the analysis of large-scale biological data and the construction of predictive models of cellular behaviour and disease dynamics. Through these systems-level approaches, researchers are able to identify personalized physiological and pathological mechanisms, tailoring diagnostics, prognostics and therapeutic strategies to the unique molecular profile of each

individual. This align with the principles of personalized medicine which enhances the potential for precision healthcare, where treatments and preventive measures are customized based on a person's genetic makeup, lifestyle and environmental exposures.[1]

The rise of systems biology is deeply intertwined with the progress of genomics, which has revolutionized our ability to study biological systems at a molecular level. Breakthroughs in genomics technologies such as high-throughput sequencing and gene expression profiling have fuelled interest in understanding how genes interact within complex networks. Key intersections between genomics and systems biology include gene expression analysis, network inference, chromatin structure studies, pathway mapping and personalized medicine. These areas benefit from integrative approaches that combine vast genomic datasets with computational modelling. As genomics continues to advance, it opens new collaborative opportunities across biomedical fields, driving more holistic biological insights.[2]

Ayurveda encompasses principles that closely align with systems biology, epigenetics and genomics, offering a holistic framework that may significantly contribute to the evolution of personalized medicine. This alignment opens promising avenues for interdisciplinary research, enabling a synergistic integration of principles of Ayurveda with modern approaches in systems biology, genomics and epigenetics to enhance the precision, effectiveness and personalization of healthcare.[3]

Methodology

A comprehensive literature search was conducted using online databases; Medline, PubMed, Embase, AMED, CAMbase, and Google Scholar. The search strategy involved the use of the keywords "*Prakriti*," "genomics," "Ayurgenomics," "epigenetics," "Ayurveda," "precision medicine," "personalized medicine," "integrated medicine," and "review" both individually and in combination, applying appropriate Boolean operators (AND, OR) to maximize retrieval. Results of literature search on different data base are given in Table 1.

Table 1 – Results of literature search in different data bases

Sl.No	Key words and their combination used	Pubmed	Google scholar	CAMbase
1	Prakriti AND genomics	38 results	2190	293
2	Prakriti AND Ayurgenomics	28	370	73
3	Prakriti AND epigenetics	5	732	113
4	Prakriti AND precision medicine	12	3370	99
5	Prakriti AND personalized medicine	30	8960	254
6	Prakriti	145	26900	1158
7	Ayurgenomics	55	591	116

Original research articles were screened based on title, abstract, and full text for relevance. Inclusion criteria comprised publications between 2000 and 2025 in English, available as full text, with a focus on *Prakriti* and genomics. Redundant or repetitive articles were excluded. All available clinical trials relevant to *Prakriti* and genomics were included. The screening process highlighted an increasing trend of incorporating molecular techniques in identifying *Prakriti*.

- **Integrative Approaches in Systems Biology: Bridging Genomics, Personalized Medicine and Ayurveda**

Throughout history, various taxonomic systems have been devised to classify individuals based on constitutional phenotypes ranging from Hippocrate's "theory of humors" to more contemporary models such as Friedman and Rosenman's "behavioral patterns" and William Sheldon's "somatotypes".[4, 5, 6] Core principles of Ayurveda are based on Theory of three humors (*Tridosha)* forms the basis of Ayurvedic

physiology, pathology and pharmacology. Three humors, described as *Vata*, *Pitta*, and *Kapha* responsible for maintenance of homeostasis in the body through their equilibrium state. Each *Dosha* governs specific physiological functions, E.g., *Vata* controls movement, including molecular transport and nerve impulses, *Pitta* oversees digestion and cellular metabolism and *Kapha* maintains structure and stability in the body.[3] Based on *Dosha* predominance, Ayurveda categorize individuals into seven basic types of *Prakriti/Deha Prakriti* or constitution.[7] *Prakriti* represents an individual's innate constitution formed during time of fertilization and remains unaltered throughout life which correlates individual's patterns of gene expression. Seven types of *Prakriti* or constitution described are *Vata*, *Pitta*, *Kapha*, *Vata-Pitta*, *Vata-Kapha*, *Pitta-Kapha* and *Vata-Pitta-Kapha Prakriti*. *Prakriti* identifies how an individual reacts to environmental conditions, lifestyle changes and drugs, and how susceptible they are to different diseases. It is one of the first ideas in preventive and personalized medicine. For guiding personalized treatment, the most critical diagnostic element is the assessment of *Vikruti*, which reflects the individual's current state of imbalance and symptoms. While *Prakruti* represents the inherent *Dosha* constitution established at conception, *Vikruti* indicates the present *Dosha* state and highlights existing imbalances or illness. Ayurvedic therapy aims to restore the patient's original state of balance as defined by their *Prakruti*.[3] *Deha Prakriti* has a crucial role in the susceptibility and prognosis of the disease and this classification guides personalized diagnosis and treatment in Ayurveda. Ayurveda incorporated different detoxification methods in daily routine. On the basis of amount of vitiation of *Dosha*, treatment can be *Shamana* (pacification) and *Shodhana* (purificatory). Higher amount of *Dosha* vitiation needs *Shodhana* procedure, which popularly known as *Panchakarama*. *Panchakarma* is specialized modality of Ayurveda, which eliminates excess *Dosha* from body through natural orifices referred as *Shodhana*, which includes *Vamana* (~emesis), *Virechana* (~purgation), *Anuvasana Vasthi* (~enema therapy), *Asthapana Vasthi* and *Nasya* (~errhine therapy).[8] Also, pathogenesis of diseases can be prevented by following *Dinacharya* and *Ritu charya* described in Ayurveda. *Dinacharya* refers to daily regimens and *Ritucharya* refers sets of activities and dietary guidelines to be followed during each season. It is also essential for every physician for the appropriate selection of the drug or therapeutic procedure, determination of the drug dosage, mode of administration and in prescribing wholesome, unwholesome diets and lifestyle. It not only helps in the prediction of a disease susceptibility but also in the estimation of disease severity or prognosis in an individual.[9, 10]

- **Why genomics matters to Ayurveda?**

Genomics is a branch of biology focuses on the evolution, function, structure, editing or mapping of genomes. It involves research of all genes at proteomics, metabolomics and transcriptome levels. It is a predictive personalized interpretation of what DNA tells about the respective individual based on genetic makeup.[11] Genomic medicine involves utilizing information derived from genomes, whether human or from other organisms and related molecules such as RNA, proteins and metabolites to inform medical decisions. With advancements in technology, it is now feasible to analyse a person's entire genome or a significant portion of it, to enable personalized risk assessment and treatment planning. As a result, health and disease conditions can now be defined by their unique molecular signatures, enabling the identification of meaningful patient subgroups and the discovery of underlying biological pathways using genome wide data. Years ago, reporters for The Wall Street Journal wrote an article titled ''New Era of Personalized Medicine - Targeting Drugs for Each Unique Genetic Profile'' which set high expectations for a new way of practicing medicine predicated on the characteristics of the individual.[12]

Personalized medicine is an evolving and dynamic area of healthcare that leverages an individual's unique clinical, genetic, genomic and environmental data. It promotes a coordinated, evidence-based and individualized approach to patient care throughout the entire health spectrum from wellness to illness. This approach aims to enhance health promotion, patient awareness and satisfaction, the customization of disease prevention, early detection and treatment strategies. By integrating insights from genomic medicine, personalized care enables a molecular level understanding of diseases to optimize prevention and therapy, even before symptoms appear. Successful implementation of personalized medicine relies on collaboration among multidisciplinary healthcare teams to ensure comprehensive and patient centred care. Though Ayurveda is in practice for thousands of years, its integration with modern medicine in clinical settings is in nascent stage. The two medical streams have different approaches to diagnosis, treatment and therapy.

Modern medicine focuses on treating diseases in an organ-specific manner, while Ayurveda takes a holistic perspective, treating the individual in a personalized manner based on their inherent *Prakriti*. In this perspective, it is important to understand applications of *Prakriti* in personalized medicine and how to integrate it with programs for various aspects such as drug development and discovery.

- **The rise of Ayurgenomics**

With the advent of DNA based tools for studying human genetic variation, CSIR-IGIB scientists explored a possible genetic basis for *Prakriti* based stratification.[13] Integrating *Prakriti* stratification with genomics first revealed the molecular and genetic basis of *Dosha* based *Prakriti*. This lead to emergence of new discipline, Ayurgenomics that seeks to bridge and build an operational framework for integrating the principles of Ayurveda with genomics approaches for translational applications by exploring the molecular basis of principles and practices. Globally, there has been a significant shift in healthcare from a reactive to a proactive approach. By combining the strengths of Ayurveda and modern medicine through Ayurgenomics, there is potential to enhance patient care and promote a more precise, integrative and effective healthcare system that embraces P4 medicine (preventive, predictive, personalized and participatory) aspects. This resonates with the principles of Ayurveda that dates back to thousands of years and are still practiced widely.[3]

- **Scope of Ayurgenomics**

Molecular basis of inter-individual differences between *Prakriti* that govern their differential health and disease trajectories, methods for phenotype-based non-invasive methods of stratification of healthy individuals, biomarkers and targets for early actionable interventions and platforms for evidence based usage of Ayurveda medicines can be achieved by the application of Ayurgenomics. In Ayurveda, the concepts of individuality/*Prakriti* that govern the baselines of health, response to environment and disease trajectories and form the basis for personalized and precision interventions. As the characteristics of individuals are defined on the basis *Dosha* predominant *Prakriti* and *Dosha* dominance regulates physiology of individual, defining preventive and treatment on this basis may help to identify the life style intervention along with medicine for its best effect.

In Ayurveda, the selection of drug and dietary regime are based on understanding of basic constitution/*Prakriti*, disease endophenotype and health status at the time of administration. The interaction of genetic networks and environmental factors is important for phenotypic diversity in health and disease. Each individual has their own genetic make up *(Prakriti)*. There are several variants in the human genome sequence, ie.,single nucleotide polymorphisms (SNP). Some of these differences are frequent and seen in a significant number of individuals. Incorporation of Ayurveda's *Prakriti* differentiation approaches with advanced genomics enabled the identification of molecular genetic basis of concept of *Dosha Prakriti* (figure 1).[3]

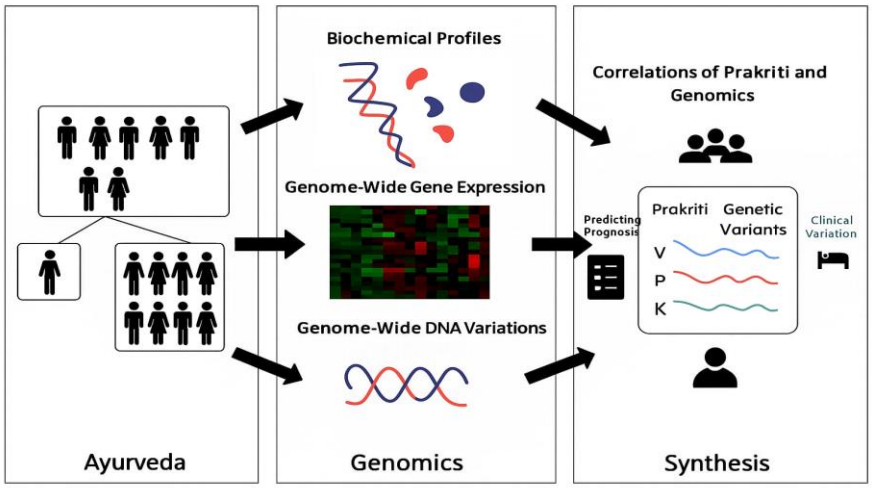

Figure 1 – Incorporation of *Prakriti* and genomics

- **Applications of Ayurgenomics**

Ayurgenomics integrates ayurvedic *Prakriti* with modern genomics enabling personalized nutrition (ayurnutrigenomics), P4 medicine (predictive, preventive, personalized and participatory) and epigenetic modulation of health (figure 2).

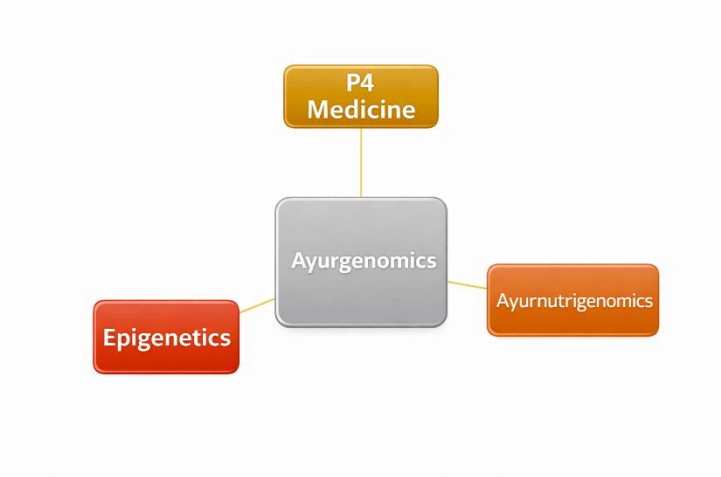

Figure 2 – Application of Ayurgenomics

- **Ayurgenomics for selfcare – Development of preventive care strategy through Ayurnutrigenomics**

In Ayurveda, food and medicine are deeply interconnected, both playing a vital role in self preservation, disease prevention and healing. The concept of *Aharam* is described as *Maha Bhaishajyam*, meaning "the greatest medicine".[14] and *Pathya Ahara* refers to food that is wholesome, soothing, and supportive of health tailored according to factors like location and season.[15] Ayurnutrigenomics, an emerging field within ayurvedic systems biology, focuses on selecting personalized diets, therapies, and lifestyle practices based on an individual's constitution (*Prakriti*) and clinical profile. This approach represents a novel direction in nutrigenomic research, aiming to design functional foods and nutraceuticals aligned with one's genetic makeup.[16] Inflammatory genes were up-regulated in *Vata* types, implies to avoid *Vata* aggravating food in inflammatory disease, who are more prone to inflammatory diseases like rheumatoid arthritis in future.[17] Advanced omics technologies can further bridge Ayurveda nutrition with modern genomics to develop a better understanding. While considering Gutmetagenomics & biotics, a study in healthy Indians showed *Prakriti*-specific microbes, Prevotella in *Vata* and Firmicutes in *Pitta*, which open the door to tailored pre/probiotic adjuvants matched to patient constitution.[18]

- **Concept of P4 (predictive, preventive, personalized and participatory) medicine and personalized drug development - From "type" to "target'**

Ayurveda, in addition to its therapeutic applications, offers a structured methodology for healthcare based on three core pillars; predictive, preventive and personalized medicine, rooted in the concept of *Prakriti* (individual constitution). In addition to its curative capabilities, provides a predictive, preventative and personalized strategy to health and illness management that has been thoroughly described in classic literature such as the *Charaka* and *Sushruta Samhita*, emphasize health maintenance and disease prevention through daily routines (*Dina Charya*) and seasonal regimens (*Ritu Charya*). The practice of *Ritu Shodhana* (~seasonal purification) prepares the body to adapt to seasonal changes, enhancing resistance to disease, all based on individual *Prakriti* variations.[19, 20] Despite its potential, this approach has not yet been fully utilized in modern drug discovery. Ayurgenomics combines Ayurvedic knowledge with modern genomics, offering a personalized strategy that considers genetic and biochemical variability. It explores how genetic differences influence disease susceptibility and drug response, using *Prakriti* as a foundational framework. The concept of *Trisutra* has been specified in Ayurveda for the fulfilment of the aim of maintaining the health of healthy persons and to cure disease of patients. Many diseases arise from complex gene-environment interactions and modern network medicine aligns with Ayurveda's *Trisutra* - cause (*Hetu*), symptoms (*Linga*) and treatment (*Aushadha*).[21] Current drug development often overlooks genetic variations in drug targets, enzymes and transporters. Ayurveda, however, inherently incorporates inter-

individual variability into treatment, recognizing that *Prakriti* influences not only disease risk but also how a person responds to medication.[3]

The Ayurgenomics approach holds significant potential for biomarker discovery in complex diseases by recognizing molecular and genomic differences across *Prakriti* types. This integrative approach may help identify populations with varying disease susceptibility and drug response enhancing its relevance in both personalized medicine and drug development.[3] For example, studies show that CYP2C19 (Cytochrome P450 2C19) an important gene in drug metabolism is down-regulated in *Kapha* individuals and up-regulated in *Pitta* types, affecting drug detoxification. This finding helps in development of *Prakriti* specific dose tables and implies Ayurgenomic labels can sit on the prescription as a genomic shorthand, reducing adverse drug reaction (ADR) risk and trial size.[22] Network pharmacology and in silico pipelines use chemogenomic data with Ayurgenomics to accelerate hit validation. [23] A study on *Triphala* in a cancer model using network pharmacology and in silico poly-targeting established a bioactive-target-disease network, supporting traditional use and suggesting new indications.[24] These findings underscore the value of integrating Ayurgenomics into precision medicine and modern drug discovery efforts.

- **Incorporation of epigenetics with Ayurveda**

Epigenetics refers to the study of how environmental and behavioural factors influence gene expression without altering the underlying DNA sequence. These reversible changes can affect an individual's phenotype, appearance, behaviour or development without changing the genotype. Factors such as diet, stress, lifestyle and environment are key components in Ayurvedic understanding, which can modify gene activity and can be inherited across generations. Ayurveda integrates both genotype and phenotype, emphasizing their influence on health. At the molecular level, mRNA, proteins and tRNA are believed to reflect the three *Doshas* regardless of ethnicity or geography. Ayurveda categorizes medicines through *Rasa* (taste, potency, effect, etc.), unlike modern pharmacology, which focuses on molecular structure. Ayurgenomics connects *Prakriti* with modern epigenetics to enhance precision medicine and thus prevents potentially affecting future generations. Nutritional deficiencies and toxins may trigger illness through epigenetic shifts. A study showed that exposure to air pollution during pregnancy has been demonstrated to alter the gestating mother, her embryo and its growing germ line, affecting the phenotypic of the third generation.[25] Stratifying populations by *Prakriti*, rather than solely biomarkers may reduce sample size needs and clarify phenotypic variability in research. [26]

- **Implications of *Prakriti* in genomics**

Previous studies show strong correlations between *Prakriti* and genetic variations particularly in HLA, CYP450 and inflammatory genes. These findings highlight's *Prakriti*'s biological basis and its role in disease variability. Integrating *Prakriti* with genetics strengthens predictive medicine, enabling early risk assessment, individualized prevention strategies and advancement of personalized health care programmes. Interpretation of findings from some previous studies with predictive medicines are given in Table 2.

Table 2 - Variability of bio markers in relation to *Prakriti* and its interpretation with predictive medicine

Biomarker	*Vata Prakriti*	*Pitta Prakriti*	*Kapha Prakriti*	Reference	Probable interpretations in predictive medicine
Genes in immune response pathways (Toll-like receptor signalling pathway)		Over expression		Prasher et al., 2008	Immune responses are flared up in *Pitta Prakriti* people with activation of pro-inflammatory cytokines. Autoimmune disease pathology activation is more prone in this *Prakriti* and therefore a thorough screening for autoimmune markers are always warranted in this *Prakriti*.

Cellular process – Apoptosis		High		Prasher et al., 2008	A high level of expression of apoptosis inducing proteins in the cells indicates a high sensitivity of tissues to chemotherapeutic agents in cancers. *Pitta Prakriti* people are more responsive to chemotherapeutic agents in certain cancers. By studying the specific proteins expressed, we can ascertain the susceptibility of individuals to specific chemotherapeutic agents.
Transport - Protein import in to nucleus	High			Prasher et al., 2008	Protein import to nucleus is the key player in gene regulation involved with disease processes as well as cell-cycle. High rate of import in *Vata Prakriti* denotes to the higher response to medicines involved with the gene transcription and formation of specific proteins. In diagnostics, expression of specific protein indicative of specific diseases like neurodegenerative diseases can be considered as biomarkers for the early diagnosis of such diseases.
Immunity - Natural killer cells(CD56) activated B cells (CD25)		Slightly higher levels of CD14 were observed in *Pitta Prakriti* samples.	CD25 and CD56 expression was significantly higher in *kapha Prakriti* samples than other *Prakriti* groups.	Rotti et al., 2014	Higher expression of Natural killer cells are associated with a high rate of tumor cell degradation and an indicator of good prognosis when expressed in larger number. B cells with CD25 is associated with active autoimmune disease activity. This can serve as a diagnostic investigation in susceptibility of autoimmune diseases in *Kapha Prakriti* individuals and devising disease specific anti-CD25 antibodies could serve as a prophylactic measure from the development of autoimmune responses.
Serum prolactin	High in *Vata*	low	Low in *Kapha* males	Prasher et al., 2008	High levels of prolactin is associated with functioning of reproductive system and in individuals of *Vata Prakriti*. This might lead to pan dysfunction of reproductive system leading to irregular menstruation and low levels of reproductive hormones. On the other hand low levels of prolactin in *Kapha Prakriti* suggest deterioration of *Ojas* by the influence of hypothalamo-pitutory axis leading to an immunological imbalance and reduced anabolic processes.
CYP2C19 gene expression		Up-regulated	Down regulated	Ghodke et al. (2011)	CYP2C19 is a major enzyme related with phase 1 drug metabolism. 10% of commonly used drugs are metabolised by this enzyme. *Pitta Prakriti* inviduals have significantly higher frequency of this isoform making them an extensive metabolizer of drugs. On the other hand *Kapha Prakriti* are poor metabolizers.

					Pitta Prakriti individuals are faster drug metabolizers and might require higher doses for maintaining therapeutic effect. *Kapha Prakrithi* individuals, being slow metabolizers are likely to accumulate drugs leading to toxic manifestation.
High density lipo protein (HDL)	High level		Lower level	Prasher et al., 2008	HDL is protective and promote reverse cholesterol transport reducing the risk atherosclerosis. *Kapha Prakriti* individual have a lower HDL level consistent with slower metabolism and accumulation of *Medha*, correlated as excessive accumulation of lipids including atherosclerotic changes with an escalated CAD risk. In *Vata Prakriti*, high level of HDL consistent with lean body mass and faster catabolise of lipids with a lower risk of CAD(coronary artery disease).
Protein sequences involved in the oxidative stress pathway		Upregu lated	Upregulat ed	Juyal et al., 2012	Oxidative stress marks the imbalance between ROS and antioxidant defence. Usually measured by markers like MDA, protein carbonyls and antioxidant enzymes like SOD, CAT etc. The key antioxidant defence pathway genes like Nrf2 shows SNP based differences among *Prakriti* subtypes. In *Pitta Prakriti* the pro inflammatory and oxidative pathways are up regulated showing a higher level of ROS production and MDA levels along with a higher compensatory antioxidant up regulation of SOD and Catalase activities. In *Kapha Prakriti*, lower base line ROS production with reduced antioxidant enzyme activity is seen.

The data presented in the above table demonstrates distinct molecular and biochemical variations among *Vata*, *Pitta*, and *Kapha Prakriti* highlighting their relevance in predictive and personalized medicine. *Pitta Prakriti* individuals exhibit heightened immune activation, pro-inflammatory cytokine expression and up regulated CYP2C19 activity, suggesting increased susceptibility to autoimmune disorders and faster drug metabolism necessitating dosage adjustments. *Vata Prakriti* shows enhanced nuclear protein import and elevated HDL levels, correlating with improved gene regulation responses and efficient lipid metabolism potentially lowering cardiovascular disease risk. In contrast, *Kapha Prakriti* is characterized by lower HDL, down regulated CYP2C19 and reduced oxidative stress response, predisposing to lipid accumulation, drug toxicity and metabolic disorders. Additionally, immune cell profiles vary with *Kapha Prakriti* showing higher CD25 and CD56 expression linking it to autoimmune activity and tumor surveillance. These biomarker based differences provide a scientific framework for integrating Ayurvedic *Prakriti* classification with modern genomics offering a foundation for individualized disease prediction, early diagnostics and therapeutic strategies.

Discussion

The integration of Ayurveda and modern genomics has given rise to Ayurgenomics, a novel discipline that provides a framework for personalized and predictive healthcare. Ayurveda, with its foundation in the *Tridosha* theory of *Vata, Pitta* and *Kapha* classifies individuals into distinct *Prakriti* types that determine physiological traits, disease susceptibility and therapeutic responses. Modern genomics, through tools such as genome-wide association studies and transcriptomics identifies genetic variations and molecular pathways underlying health and disease. Together, these approaches bridge traditional constitution based stratification with molecular-level insights advancing precision medicine. Ayurgenomics enables the identification of genotype–phenotype correlations across *Prakriti* subtypes offering insights into differential immune responses, metabolic pathways and drug metabolism. For instance, CYP2C19 expression is upregulated in *Pitta* and downregulated in *Kapha* individuals influencing drug detoxification and dosage requirements.[29] Such findings support the development of *Prakriti* specific pharmacogenomic strategies potentially reducing adverse drug reactions and improving therapeutic efficacy. Similarly, gut-metagenomic studies reveal *Prakriti* specific microbial distributions suggesting tailored probiotic interventions.[18] The concept of P4 medicine aligns closely with Ayurvedic principles particularly through *Prakriti* based dietary and lifestyle recommendations. Ayurnutrigenomics, a subfield of Ayurgenomics emphasizes constitution specific diets and functional foods, thereby promoting preventive health.[18] Additionally, integration with network pharmacology has validated traditional formulations such as *Triphala* for novel therapeutic applications.[23,24] Epigenetic perspectives further strengthen this convergence, as Ayurveda emphasizes lifestyle, diet and environment factors now known to modulate gene expression without altering DNA sequence. This resonates with modern findings that environmental exposures can induce transgenerational epigenetic effects. Ayurgenomics represents a translational model of integrative systems biology, combining ancient holistic wisdom with modern molecular insights. By stratifying populations based on *Prakriti* and integrating genomic data, it offers a powerful tool for biomarker discovery, personalized drug development and preventive strategies advancing global healthcare toward a more individual centered, precision based paradigm.

Limitations

Prakriti is the basic clinical denominator in Ayurveda, the central issue of Ayurgenomics may be implementing concept of *Prakriti* in clinical practice. A major challenge in assessing *Prakriti* of an individual is, the assessment is a tedious process as compared to a usual consultation in OPD settings. Variety of *Prakriti* diagnostic methods have been used in diverse studies, but only a few of them have been standardized. Although advancement has been achieved, due to the extremely complicated nature of gene expression in the progress of illness states, the complete development of the concept of Ayurgenomics may take longer than expected. Robust scientific validation of Ayurvedic principles requires large-scale, multi-center clinical trials to confirm findings. Additionally, clear ethical guidelines must be developed for the responsible use of genetic data in Ayurgenomics. Population diversity, data sovereignty(as per personal Data Protection Act 2023) and benefit sharing (under the Nagoya Protocol) are also challenges faced in the advancement of Ayurgenomics.[27]

Future road map

Even though traditional medical systems are in still exist and widely practiced in many nations and around the globe, further research into their preventative and rehabilitative treatment programs is required. The quantitative approach to the qualitative assessment of *Prakriti* for the practice of personalized medicine is essential. Successful implementation depends on strong collaboration between Ayurvedic practitioners and modern scientists. Next level application of Ayurgenomics is linking *Prakriti* with dermatoglyphics offer a non-invasive, reliable tool for personalized health assessment and understanding individual predisposition to disease. A quantitative tool such as software could eliminate much of the subjectivity such that it could be reiteratively tested, modified and adopted to provide similar *Prakriti* determination. Therefore, considering the immense potential, an interdisciplinary approach to interrogate Ayurvedic principles in the context of contemporary medicine such as a million-sample pan-omics atlas integrating

genome, epigenome, microbiome, exposome and detailed Ayurvedic phenotypic data, AI-driven simulations of herb-gene-*Dosha* interactions for insilico toxicology and regulatory framework for developing guidance on Ayurgenomic companion diagnostics is essential. Continued research and validation can help to establish it as a valuable tool in global personalized healthcare systems without inter-observer variations. [28]

Conclusion

Over half of India's population relies on Ayurveda, an ancient Indian medical system that is now gaining global recognition as an alternative form of medicine. Central to Ayurveda are the concepts of *Tridosha* and *Prakriti*, which help classify individuals, both healthy and diseased based on their physiological and psychological traits. These principles form the basis for personalized healthcare, disease prevention and the promotion of overall well being. Ayurgenomics, an emerging interdisciplinary field bridges traditional Ayurvedic knowledge with modern genomics, offering a personalized approach to healthcare. It aims to provide a scientific understanding of Ayurvedic principles while integrating its preventive and wellness based practices into contemporary medical frameworks. This approach shifts the focus from treating diseases to promoting holistic patient wellness. Closely aligned with fields like personalized, preventive, lifestyle and functional medicine, Ayurgenomics aspires to enable precision medicine. By integrating the concept of *Prakriti* with genetic profiling, enables identifying vulnerable population for early disease prediction, targeted prevention and tailored treatments. This approach holds promise for managing complex, chronic disorders by considering both genetic and phenotypic variations. It also contributes to drug response prediction and lifestyle guidance based on an individual's unique biological makeup. As a result, Ayurgenomics enhances precision medicine while honouring holistic principles. This integrative model holds the potential to revolutionize healthcare by merging traditional wisdom with modern biomedical research.

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