Journal for Re Attach Therapy and Developmental Diversities
eISSN: 2589-7799
2023 August; 6 (10s): 2490 - 2495

Concept of Genetics in Ayurveda: An Integrative Review of Heredity, Prakriti, and Genomic Correlations

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Abstract

The heredity and traits are concepts of modern genetics; however, classical Ayurvedic literature contains descriptions of genetics with concept of Garbhaj bhava, Prakriti, and kulaj vikara etc. In Ayurveda concepts of genetics and heredity are explained through terminologies such as Beeja (seed), Beeja-Bhaga (subdivision of the seed), Beeja-Bhagavayava (subcomponents of hereditary units), and Prakriti (constitutional phenotype). These concepts can be conceptually co-related with the concept of genes, chromosomes, genotype–phenotype interactions, and personalized medicine. Recently there are many studies related to prakriti and genomes using modern diagnostic procedures. In this review we try to explain the concepts of genetics in ayurveda and their possible correlation in modern genetics. we also discuss the limitation, challenges and future research possibilities in Ayurgenomics.

Keywords: Ayurveda, Genetics, Heredity, Prakriti, Ayurgenomics, Epigenetics, Personalized Medicine, Genomics

Introduction

Genetics is a major branch of biological science concerned with heredity, variation, gene expression, and transmission of biological traits across generations. Since the elucidation of DNA structure and the development of molecular biology, genetics has become important to biomedical sciences, contributing significantly to precision medicine, pharmacogenomics, and predictive healthcare. However, concepts related to hereditary transmission and constitutional individuality were extensively documented in ancient Ayurvedic literature long before the emergence of molecular genetics [5].

Ayurveda, the traditional Indian system of medicine, is fundamentally based on individualized healthcare. Classical Ayurvedic treatises such as the *Charaka Samhita* and *Sushruta Samhita* describe the transmission of physical, psychological, and pathological traits through reproductive elements known as *Beeja* [5,6]. Furthermore, Ayurveda explains constitutional diversity through the doctrine of *Prakriti*, which defines an individual's inherent psycho-physiological constitution established during embryogenesis.

In recent decades, the emergence of Ayurgenomics has stimulated scientific exploration of possible molecular correlates of Ayurvedic constitutions. Several studies have demonstrated associations between *Prakriti* phenotypes and genomic variability, immune signatures, metabolic profiles, and disease susceptibility [1,3]. Such findings suggest the possibility of integrating Ayurvedic constitutional biology with modern precision medicine.

Nevertheless, direct equivalence between Ayurvedic concepts and modern genetic structures should be approached cautiously. Ayurvedic descriptions are primarily functional, philosophical, and observational, whereas modern genetics is based on genes, DNA and chromosomes [7]. Therefore, comparative analysis requires critical scientific explanation rather than conceptual correlation.

This review critically examines the concept of genetics in Ayurveda and comparatively analyses it with

concepts of modern genetic science. The manuscript also discusses emerging trends in Ayurgenomics, and future perspectives in integrative genomic medicine with concepts of genetics in *Ayurveda*.

Methodology

This review was done using literature available online inform of journals, Reasearch papers and other scholarly relevant content.

Concept of Heredity in Ayurveda

Beeja: The Reproductive Seed

The term *Beeja* in Ayurveda refers to the reproductive element responsible for the formation of embryo. Ayurvedic texts state that healthy *Shukra* (sperm) and *Artava* (ovum) unite properly to give rise healthy progeny. [5].

The concept of *Beeja* represent conceptual resemblance to the modern understanding of gametes carrying hereditary information.

Ayurvedic Concept	Modern Genetic Equivalent
Beeja	Gametes
Beeja Dushti	Genetic mutation
Shuddha Beeja	Genetically healthy reproductive cells

However, these correlations should be made cautiously because Ayurvedic descriptions are primarily observational unlike modern genetics.

Beeja-Bhaga and Beeja-Bhagavayava

Ayurveda further subdivides hereditary units into *Beeja-Bhaga* and *Beeja-Bhagavayava*. Classical texts describe that defects in these subdivisions may produce congenital abnormalities [6].

From a comparative perspective, these concepts resemble:

- Chromosomes
- Genes
- Gene loci
- Molecular hereditary determinants

Kulaja Vikara: Familial Disorders

In ayurveda concept of *Kulaja Vikara* (transmission of diseases within family) explain the concept of hereditary transmission of genes. The Ayurvedic concept of *Kulaja Vikara* refers to diseases transmitted within families. Classical Ayurvedic texts describe hereditary predisposition in conditions such as *Madhumeha* (diabetes), Skin disorders, Hemorrhoids etc.

Modern medicine similarly explains hereditary and multifactorial disorders influenced by genomic susceptibility and environmental interactions [7].

Prakriti and Constitutional Genetics

Concept of Prakriti

Prakriti refers to the innate psycho-physiological constitution of an individual determined at the time of conception and embryogenesis. Ayurveda classifies *Prakriti* into,*Vata*,*Pitta*,*Kapha,dwandaj,tridoshaj.*

Prakriti determine,Physical characteristics,Metabolic tendencies,Psychological attributes,Disease susceptibility,Drug responsiveness

This constitutional framework resembles the genotype–phenotype relationship in modern genetics [1].

Factors affecting Prakriti

In *Ayurveda* there are multiple factors affecting formation of *Prakriti*,Parental constitution,Maternal

diet and lifestyle, Psychological status during conception, Seasonal influences,Dominance of *Doshas* at time of conception. These multiple factors can be correlated with modern genetic model of multifactorial.

This multifactorial model aligns conceptually with modern understanding of:

- Genetic inheritance
- Epigenetic regulation
- Maternal-fetal interactions
- Environmental modulation of gene expression
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Prakriti and Personalized Medicine

Ayurveda explains concept of individualized medicine based on *Prakriti*. Drug, diet and lifestyle as per prakriti explained in detail in *Ayurveda*. [2].

Similarly, modern precision medicine aims to individualize healthcare according to:

- Genetic profile
- Biomarkers
- Metabolic characteristics
- Pharmacogenomic variability

Thus, *Prakriti can be* considered an early constitutional model analogous to personalized medicine.

Comparative Analysis of Ayurvedic and Modern Genetic Concepts

Heredity

Ayurveda	**Modern Genetics**
Traits inherited through Beeja	Traits inherited through DNA
Defective Beeja causes abnormalities	Mutated genes cause disorders
Parental health influences progeny	Epigenetic inheritance affects offspring

Constitutional Diversity

Ayurveda	**Modern Biology**
Prakriti	Phenotype
Dosha predominance	Genetic variability

Disease Susceptibility

Prakriti and susceptibility to specific type disorder as per Ayurveda text:

- Vata: neurological disorders
- Pitta: inflammatory disorders
- Kapha: obesity and metabolic diseases

Modern genetics similarly recognises disease susceptibility through genomic profiling [3].

Ayurgenomics: Bridging Ayurveda and Molecular Biology

Ayurgenomics is an emerging interdisciplinary field integrating Ayurveda with genomics to understand constitutional variability and individualized healthcare.

Genomic Correlations with Prakriti

Several studies have identified associations between *Prakriti* and:

- HLA polymorphisms
- CYP450 enzyme variations
- Immune-response genes
- Metabolic signatures

Govindaraj et al. demonstrated genome-wide correlations associated with Ayurvedic constitutional

types [1]. Similarly, Prasher et al. identified differential gene expression patterns among extreme *Prakriti* phenotypes [8].

Recent studies have strengthened the molecular basis of *Prakriti*-based stratification through genomics, transcriptomics, metabolomics, and systems biology approaches [3,4].

Despite these promising findings, major limitations persist. Therefore, large-scale multicentric validation studies are required.

Epigenetics and Ayurveda

Epigenetics is the study of how behaviours and environmental factors cause changes that affect how gene express.

Ayurveda strongly emphasizes:

- *Ahara* (diet)
- *Vihara* (lifestyle)
- *Dinacharya* (daily regimen)
- *Ritucharya* (seasonal regimen)
- Mental health regulation

Modern studies demonstrate that nutrition, stress, physical activity, and environmental factors influence DNA methylation, Histone modification, Non-coding RNA activity [9]

Consequently, Ayurvedic preventive healthcare principles demonstrate substantial conceptual alignment with epigenetic science.

Pharmacogenomics and Ayurvedic Therapeutics

Drug response remains a major challenge in clinical medicine. Ayurveda Explained such variability through constitution-specific therapeutics.

Potential integrative applications include:

- *Prakriti*-based drug response prediction
- Personalized herbal medicine
- Constitution-guided therapeutics

Contemporary Ayurgenomics research increasingly supports the role of constitutional phenotyping in predictive and participatory medicine frameworks [4,10].

Reproductive Health and Genetic Counseling in Ayurveda

Ayurveda described preconception care through concepts such as:

- *Garbhadhana Samskara*
- *Beeja Shuddhi*
- Maternal and paternal health optimization

Recommendations included:

- Proper nutrition
- Psychological stability
- Detoxification
- Ethical lifestyle practices

Modern reproductive medicine similarly emphasizes:

- Genetic counseling
- Prenatal screening
- Preconception care
- Maternal wellness

Thus, Ayurveda helps in prevention of hereditary diseases in future progeny.

Discussion:

Modern genetics initially explained only about genes, hereditary etc but later concept of epigenetics

also comes in limelight that how environment diet and lifestyle affect genes expression.
Ayurveda has long maintained that:

- Diet
- Lifestyle
- Mental status
- Environmental adaptation

can significantly modify disease outcomes despite inherited predispositions [9].

Research Gaps and Scientific Challenges

Despite promising conceptual correlations between Ayurvedic principles and modern genetics, several scientific limitations continue to hinder the advancement of Ayurgenomics. One of the major challenges is the absence of a standardized and universally accepted method for assessing *Prakriti*, which leads to variability in classification and reduces reproducibility across studies. Additionally, molecular validation remains limited, as current evidence is largely based on associations rather than well-established biological mechanisms. Another significant limitation is the small sample size used in many Ayurgenomic studies, which affects statistical reliability and limits generalization of findings. Furthermore, establishing a direct correlation between Ayurvedic concepts and modern genetic frameworks remains challenging because traditional Ayurvedic principles are holistic and individualized, whereas genetics focuses on measurable molecular parameters. These limitations highlight the need for larger, multidisciplinary, and methodologically standardized research to strengthen scientific evidence in this emerging field.

Future Perspectives

The integration of Ayurveda with genomics may significantly contribute to:

- Predictive medicine
- Precision therapeutics
- Preventive healthcare
- Systems biology
- Integrative medicine

Future research priorities include:

1. Standardized *Prakriti* phenotyping
2. Genome-wide association studies
3. Multi-omics analysis
4. Epigenetic profiling
5. Artificial intelligence-assisted constitutional assessment
6. Large-scale cohort studies

Multi-omics integration and systems biology approaches are expected to enhance the scientific validation of Ayurvedic constitutional biology [4].

11. Conclusion

In Ayurveda , theoretical framework for understanding heredity, individual constitutional variations, and predisposition to diseases through concepts such as *Beeja*, *Beeja-Bhaga*, *Kulaja Vikara*, and *Prakriti*. These traditional concepts show notable similarities with contemporary fields including genetics, genomics, and personalized medicine.

Nevertheless, such associations should be interpreted with caution, as Ayurvedic constitutional principles are primarily based on observational and holistic approaches rather than molecular characterization. Recent developments in Ayurgenomics have revealed potential biological associations between Ayurvedic constitutions and genomic patterns; however, strong mechanistic evidence to establish these relationships conclusively is still insufficient.

The convergence of Ayurvedic constitutional concepts with modern genomic science has the potential to support the development of an integrated healthcare approach that combines molecular accuracy with holistic medical principles. Continued interdisciplinary and evidence-driven research is necessary to validate these associations scientifically and facilitate their application in predictive, preventive, and personalized healthcare practices.

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