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Chapter 3: Epigenetics – An Ayurvedic view with respect to Prakriti

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Abstract:

Epigenetics involves changes in gene activity caused by external influences, without altering the DNA sequence itself. These modifications regulate gene expression and can be passed down across generations. Various elements such as lifestyle choices, dietary habits, emotional stress, and environmental exposures are known to trigger epigenetic changes. Ayurveda, known as the "science of life," acknowledges and addresses these same factors, thereby influencing Deha Prakriti (the body's physiological constitution, akin to phenotype) and indirectly impacting Janma Prakriti (the inherent constitution at birth, comparable to genotype). From this perspective, epigenetic mechanisms align closely with Ayurvedic principles. Ayurveda emphasizes the importance of health management from even before conception, continuing throughout an individual's life. Classical Ayurvedic practices such as Dinacharya (daily routines), Ritucharya (seasonal regimens), Yoga, and Sadvritta (ethical conduct) are believed to help regulate gene expression and mitigate the potential adverse effects of inherited traits. This paper explores how Ayurvedic wisdom reflects the concepts of epigenetics and offers practical strategies to positively influence genetic expression through disciplined living as guided in traditional texts.

Keywords: Ayurveda, Janma Prakriti, Epigenetics, DNA, Ahara, Vihara, Charyas

1. Introduction

Ayurveda, a holistic system of medicine that traces its origins to the ancient Vedic civilization of India, is often described as the "Science of Life," derived from the Sanskrit terms Ayus (life) and Veda (knowledge or science) (Sharma et al., 2016). It offers a comprehensive framework for maintaining health and balance in the human body. The core objective of Ayurveda is encapsulated in the principle: “Swasthasya Swasthya Rakshanam, Aaturasya Vikara Prashamanam”—that is, preserving the health of the healthy and treating illness in the diseased (Sharma et al., 2015). Ayurveda provides guidance throughout every stage of life, including prenatal, postnatal, childhood, and adulthood, integrating physical, mental, and social dimensions of health. It emphasizes routines aligned with nature, prescribing specific times for sleeping, waking, eating, exercising, studying, meditating, and engaging in other daily tasks.

The Ayurvedic concept of Prakriti can be interpreted through the lens of modern genomics. It reflects inherent constitutional types determined by the dominant Doshas—Vata, Pitta, or Kapha—and remains constant throughout life. These constitutional types exhibit strong genetic underpinnings, allowing individuals to be grouped based on observable physical and behavioral traits.

In biological science, the distinction between living and non-living systems is defined by the presence of deoxyribonucleic acid (DNA) in living organisms. Variability among living beings arises primarily from the arrangement of nucleotide bases within their DNA sequences, which form genes. The discipline that explores the structure and function of these genes is termed genetics, derived from the Greek word genetikos, meaning “origin” or “source.” Genetics is deeply interconnected with the study of biological information systems.

In contrast, epigenetics refers to changes in gene expression that do not involve alterations to the DNA sequence itself (Sharma H et al., 2020). The term "epigenetics" implies modifications that exist on top of the genetic code. These changes can activate or silence genes through mechanisms such as DNA methylation, histone modification, chromatin remodeling, and the influence of micro-RNAs (miRNAs) (Moore, L.D. et al., 2013). While the underlying genotype—representing the fixed genetic makeup or Janma Prakriti in Ayurvedic terms—remains stable, the phenotype or Deha Prakriti reflects variable physical and behavioral traits influenced by external and internal factors.

Research indicates that less than 2% of the human genome comprises protein-coding genes (Sharma H et al., 2020). The genotype, being relatively unaltered unless exposed to harmful substances, directs the formation of the phenotype. However, gene

expression is highly susceptible to epigenetic influences, which are believed to account for nearly 90% of biological responses and health outcomes over a lifetime. In Ayurveda, these epigenetic effects are akin to Karma—actions that leave imprints on the body and mind, ultimately influencing genetic expression.

The phenotype is inherently fluid and responsive to lifestyle and environmental factors. Deviations from balanced living can disrupt this equilibrium and lead to disease. Ayurveda offers detailed lifestyle and dietary guidelines—such as Matra Ahara Vihara (measured eating and living), Sadvritta (ethical conduct), Dinacharya (daily routine), Ritucharya (seasonal regimen), Na Vegandharaneeya (not suppressing natural urges), and Matrashiteeya (appropriate food intake)—to maintain health and prevent illness. Adhering to these principles fosters harmony between the individual and their environment, promoting overall well-being.

2. Literature review

2.1 Modern review

Epigenetics encompasses the study of heritable changes in gene activity that do not involve alterations to the underlying DNA sequence. These changes influence how genes are turned on or off and are influenced by external or environmental factors. Unlike genetic mutations, epigenetic modifications affect gene function without changing the DNA sequence itself.

DNA Methylation

This is a biochemical process where methyl groups are added to the DNA molecule, typically at cytosine bases. These additions can influence the structure of DNA, making certain regions less accessible for transcription, thereby reducing gene activity (Kapil S et al., 2020).

Histone Modification

DNA in the nucleus is tightly wound around proteins known as histones, forming a structure called chromatin. This packaging helps in condensing the DNA to fit within the nucleus. Depending on how tightly DNA is coiled around histones, gene expression can either be suppressed or activated. When histones are modified to loosen their grip on DNA, genes become more accessible and can be expressed more easily. Conversely, tight binding can silence genes by preventing access to transcription machinery (Kapil S et al., 2020).

Chromatin Remodeling

Chromatin remodeling refers to structural changes in chromatin that make certain regions of DNA either more compact or more open. This dynamic process is crucial for regulating gene expression by allowing or restricting access of transcription factors and other regulatory proteins to the DNA (Kumar R et al., 2016).

MicroRNAs and Non-coding RNAs

MicroRNAs (miRNAs) are short RNA molecules that do not encode proteins but play a vital role in regulating gene expression. They typically bind to messenger RNA (mRNA) molecules and prevent them from being translated into proteins, effectively silencing the gene. Other non-coding RNAs (ncRNAs) also influence gene regulation at various levels, including transcriptional and post-transcriptional stages (Lu T. X et al., 2018; Kapil S et al., 2020).

Environmental factors such as nutrition, physical activity, stress, and prenatal conditions can significantly influence gene expression through epigenetic mechanisms. These modifications are not only limited to the individual but may also be inherited by the next generation. During embryogenesis, epigenetic marks are deposited onto chromatin, shaping gene activity in developing cells. Interestingly, most of these epigenetic markers are erased when sperm and egg unite during fertilization—a process known as reprogramming—enabling the embryo to reset gene expression patterns (Kapil S et al., 2020).

In the early stages of development, the fertilized egg is composed of undifferentiated stem cells that lack defined epigenetic signatures. As these cells proliferate and interact with their environment, specific epigenetic marks begin to form, directing cells toward particular fates. Epigenetic processes are active from the formation of gametes (spermatogenesis and ovulation) and continue throughout the individual's life, continually shaped by lifestyle, diet, and mental health.

2.2 Ayurvedic review

Ayurveda is the science of knowledge regarding life which deals with Hita Ayu, Ahita Ayu, Sukha Ayu and Dukha Ayu. The dichotomous use of Ayurveda are - preventive and promotive measure for Swasthya and curative measures for Aatura. It also provides insight into the context of Maturaahara vihara, Sadvritta, Dinacharya, Ritucharya, Na Vegandharaneeya and Matrashiteeya etc. which plays a major role in enhancing the immunity andmaking them resistant towards infectious substances and diseases. The Ahara ,Vihara and Charyas mentioned in Ayurveda are described below

which will cause favourable epigenetic changes if followed appropriately according to the constitution (Prakriti) of individual.

a) Matrija Ahara-Vihara and Shad Garbhakara Bhavas

Ayurveda recommends that dietary habits and lifestyle practices be managed from the time of menstruation, known as Ritucharya, to ensure the ovum is in optimal condition for conception. Should conception occur, following Ayurvedic preconception practices, the woman is advised to adhere to specific prenatal dietary and behavioral guidelines to support healthy fetal development. After childbirth, postpartum care is outlined in the SutikaParicharya. Throughout life, individuals are encouraged to maintain health by following Ahara Vidhi (dietary norms), Dincharya (daily routines), and Ritucharya (seasonal adaptations). To produce a healthy child, six key procreative factors (Shad Garbhakarabhavas) are essential, including Matrija, Pitrija, Atmaja, Rasaja, Satmyaja, and Satvaja (Sharma et al., 2004). Each of these influences specific aspects of physical development, function, or psychological traits in the fetus. A combination of a healthy mother and father, righteous conduct, balanced diet and routines, and a stable mental state contribute significantly to favorable epigenetic outcomes in the child.

b) Ahara and Agni

Ayurveda holds food (Ahara) in high regard, considering it one of the three main pillars of life support (Thrayo-Upasthamba) (Sharma et al., 2015). The tradition outlines dietary principles that include selecting the right foods, appropriate combinations, proper cooking techniques, storage methods, hygienic eating environments, and mind-ful eating practices. Central to well-being is the concept of Agni—the digestive fire. Even the most nutritious food may fail to benefit the body if digestion is compromised. Properly functioning Agni ensures complete digestion, while impaired Agni can lead to the production of Ama, a toxic byproduct of incomplete digestion that is associated with various diseases (Sharma H et al., 2016).

c) Dinacharya

Dinacharya refers to a structured daily routine designed to promote overall health and a meaningful life. This regimen includes waking during Brahma Muhurta (approximately between 4:00 a.m. and 5:30 a.m.), washing the face with cold water (Achamana), attending to elimination (Shoucha karma), brushing the teeth (Danta dhavana), cleaning the tongue (Jihvanirlekhana), and practices like oil pulling (Gandusha-Kavala), eye care (Anjana), nasal oil application (Nasya), oil massage (Abhyanga), herbal powder massage (Udvartana), and bathing (Snana). These practices foster cleanliness, physical vitality, mental calmness, and longevity (Pt. Paradkar Shastri, 2014).

d) Ritucharya

Ayurveda advocates for a lifestyle that aligns with the natural seasonal cycles through the practice of Ritucharya. Ancient texts provide detailed dietary and lifestyle recommendations for each of the six seasons. Adjusting food and behavior to match seasonal variations helps maintain equilibrium in the body. Modern scientific studies in nutritional epigenetics also reveal that diet plays a role in influencing gene expression, serving as an environmental factor that can affect health outcomes (Pt. Paradkar Shastri, 2014).

e) Sadvritta

Ayurveda also highlights the importance of ethical and moral conduct (Sadvritta) for mental balance and emotional stability. These behavioral codes help maintain psychological well-being and social harmony (Pt. Paradkar Shastri, 2014).

f) Vega (Dharaniya&Adharaniya)

The management of natural urges, both suppressible (Dharaniya) and non-suppressible (Adharaniya), is essential in Ayurveda for maintaining holistic health. Respecting these principles supports the balance of body, mind, and spirit (Pt. Paradkar Shastri, 2014).

In addition, Ayurveda addresses mental health through the regulation of mental stress (Manasa Tivra) and emotional fluctuations (Manas Vritti). Practices such as yoga, controlled breathing, meditation, full-body massage, herbal therapy, and psychotherapeutic approaches are recommended. Herbal medicines in Ayurveda are rich in active compounds like flavonoids, terpenes, and polyphenols, many of which have demonstrated potential in modulating epigenetic activity without harmful side effects.

Examples:

Certain foods rich in B vitamins have been shown to affect DNA methylation. For instance, curcumin—a bioactive compound from Curcuma longa (turmeric)—acts as a histone deacetylase (HDAC) inhibitor (Liu, H.-L et al., 2005).

Withaferin A, an active component of Withaniasomnifera (Ashwagandha), has demonstrated the ability to suppress DNA methyltransferases and HDACs in breast cancer cells, inducing programmed cell death in these cells (Royston, K.J et al., 2017; Royston, K.J et al., 2018).

3. Methods and Methodology

Source of references were collected from classical Ayurveda texts- Brihatrayee, peer reviewed articles, journals and websites like Pubmed, Google scholar, etc.

By combining both sources, the research examines how principles of Ayurveda can shape gene expression via lifestyle, diet, and plant-based interventions with an emphasis on epigenetic mechanisms and correlation with contemporary scientific evidence.

4. Results and discussions

Epigenetic traits can be inherited across generations and play a significant role in shaping the subtle differences that make each individual unique. It is widely recognized in medical literature that the majority—about 95%—of diseases are not genetically inherited. This indicates that parental lifestyle and dietary choices can strongly influence the epigenetic makeup of their children. Epigenetic mechanisms are partially responsible for certain congenital and genetic irregularities. These modifications, once established, can persist through successive cell divisions and may even be passed on to future generations.A wide range of factors—including prenatal and early childhood development, environmental exposures, pharmaceutical use, aging, and dietary intake—can affect epigenetic regulation. By maintaining healthy habits throughout life, we have the potential to modulate the expression of genes that contribute to disease. Classical Ayurvedic texts offer several recommendations to help manage these epigenetic influences. These include daily routines, seasonal lifestyle adaptations, disciplined dietary practices, ethical behavior, rejuvenating therapies, detoxification, and mind-body practices such as Yoga and meditation for psychological well-being.Through conscious lifestyle choices; it is possible to bring about lasting epigenetic modifications. These changes, whether beneficial or harmful, may be passed on to subsequent generations, potentially altering their genetic expression as well.

Ayurvedic concepts shape epigenetics by encouraging harmonious ways of living that affect gene expression without modifying genetic codes. Essential elements include individualized nutrition (Aahaar), daily routines (Dinacharya), stress relief with meditation and Yoga, and cooperation with the environment. Ayurveda deals with the mind-body interface, minimizing stress-mediated epigenetic alterations and optimizing cellular well-being. Turmeric andAshwagandha are some examples of herbs that aid in gene control by exerting anti-inflammatory and antioxidant actions. Balancing Doshas (Vata, Pitta, Kapha), Ayurveda maximizes gene expression, maintaining health and

preventing illness. Integrating them can favourably alter epigenetics, bringing long-term wellness and better intergenerational health.

5. Conclusions

The field of epigenetics, which governs how genes are expressed, is advancing rapidly in contemporary science. Interestingly, ancient Ayurvedic texts offer extensive insights that align closely with the principles of this emerging discipline. According to Ayurveda, four primary influences play a vital role in shaping an individual's physical constitution, or Deha Prakriti. These include one's daily habits and behavior, dietary choices and digestive health, mental stress, and environmental exposures. Depending on how these are managed, they can either support or disturb the body's phenotype.These influences interact with the Janma Prakriti—the innate constitution determined at birth—modifying how genes are expressed without altering the underlying genetic code. Ayurveda offers a holistic framework to optimize these four factors, thereby promoting favorable gene expression and overall health through epigenetic pathways. This suggests that epigenetics could be a central biological mechanism through which Ayurvedic practices exert their effects.Recognizing this intersection between Ayurveda and epigenetics may foster greater collaboration between traditional and modern medical systems. It can pave the way for integrated approaches to health and well-being. Furthermore, scientific exploration of how Ayurvedic interventions influence gene activity could deepen the mutual understanding between contemporary biomedical science and Ayurveda.

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