

Ayurveda: Science of life, genetics, and epigenetics

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Abstract

Ayurveda is a traditional system of medicine originated in the ancient *Vedic* times of India. This body of knowledge is found in well-documented texts such as the *Charaka Samhita* and *Sushruta Samhita*, and describes physiology and interrelated systems of the body, variations in human constitution, surgery, herbal use, and health-promoting recommendations. Ayurveda is translated as the “Science of Life;” *Ayus* = Life, and *Veda* = knowledge/science. The principles and treatment modalities have endured over time. For Ayurveda to be appreciated by Western medical researchers, this traditional system of medicine needs to be understood in terms of modern science. The current theories of physiology that support Ayurvedic approaches need to be explored. Herein, one approach of how the realm of epigenetics can help elucidate the mechanisms of Ayurveda has been described.

Keywords: Ayurveda, epigenetics, genetics, *Vedic*

Introduction

Ayurveda is a traditional system of medicine originated in the ancient *Vedic* times of India. It is a comprehensive approach to health and homeostasis that addresses body, mind, emotions, spirit, and environment. Ayurveda is translated as the “Science of Life;” *Ayus* = Life and *Veda* = knowledge/science. This knowledge is found in ancient Ayurvedic texts such as the *Charaka Samhita*^[1] and *Sushruta Samhita*,^[2] and describes in detail the physiology and interrelated systems of the body, variations in human constitution, surgical techniques, use of herbs and herbal mixtures, and many other modalities for achieving and maintaining health. Ayurveda uses the principles of nature to distinguish and define different body types or constitutions, each with unique characteristics and response to the environment, and with predispositions to diseases and reactions to drugs. Ayurveda promotes constitutionally dependent guidelines for maintaining balance and protecting against disease.^[3]

Current medical research emphasizes personalized medicine and systems biology, and will benefit by going beyond reductionism in the scientific method to model and study whole biological systems. Reductionism helps to define cellular and molecular actors in the processes of health and disease. Sophisticated informatics gained from highly technical genomics, proteomics, and metabolomics studies of human tissue samples can characterize multiple molecules involved

in the tissue at that moment. However, these data sets may be static and defy the complexity of intratissue interactions and dynamic environmental responses.

There is a need to understand disease and pathology in terms of ecological homeostasis, how the individual/environment interactions are in a dynamic equilibrium when they are healthy, and how imbalances in the homeostatic system become seeds for illness. Ayurveda can provide a universal perspective to the nature of life, health, and even to cell and molecular biology. Ayurvedic paradigms can be explored to elucidate cellular and molecular genetic mechanisms. One way to understand Ayurveda may be through the science of epigenetics. It is estimated that epigenetic factors play a large role in determining lifelong health. Epigenetics mediates molecular nuclear responses to the environment in time and over generations. Effects of Ayurvedic herbs and lifestyle recommendations may be explained in terms of epigenetic mechanisms.

Epigenetics and Phenotype

Epigenetics describes the dynamic relationship between the environment and gene expression. Epigenetics refers to how

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gene expression is regulated on the level of the chromosomes, and what part of the DNA is open for reading (transcription) to produce proteins (translation). It refers to external modifications to the DNA that turn genes “on” or “off.” These modifications do not change the DNA sequence, but control gene expression. Epigenetic changes are carried out by DNA methylation and the interaction of DNA and proteins called histones. DNA methylation refers to the addition of a methyl group (CH3) to the cytosine nucleotides in the DNA strand itself. DNA methylation patterns are passed on from parents to child and are vital to human growth and development, enabling a single cell to grow into a complex multicellular organism made of different tissues and organs. However, methylation can result in the inappropriate silencing of genes such as tumor suppressor genes.^[4,5] Many of these processes are altered in cancer, and there is a great interest in understanding these processes to control the cancer progression.

Histones are proteins that compact the genome (DNA) into a large nucleoprotein complex known as chromatin. For accessibility of DNA for processes such as replication, transcription, repair and recombination, interaction between histones and DNA is required. It represents an important regulatory factor for processes that require direct access to the DNA.^[6] In this way, histones regulate the way DNA expresses itself, which is part of the epigenetic mechanism.

Epigenetics deals with virtually everything that happens to the expressed genes in the phenotype during stages of the lifespan, for example, prenatal, postnatal, childhood, lifetime social experiences, diet, nutrition, exposure to toxins, lifestyle, behavior, stress and environment, and how these impact the expression of genes.^[7-12] The phenotypic expression differs in each individual depending on which part of the DNA (genes) is being expressed, based on past exposures, experiences and impressions, knowledge of which is embedded in the genes in the form of these epigenetic modifications. The phenotype is dynamic and always changing. The phenotype is affected primarily by the factors listed in Table 1. These factors will keep the expressed phenotype in good health if the proper principles of life and living are followed. If the proper principles are not followed, alterations in health occur and disease manifests. These principles are addressed in detail in Ayurveda (discussion to follow).

Research is validating the role of different factors that modify the epigenetic patterns. Several lifestyle factors – such as diet, obesity, physical activity, tobacco smoking, alcohol consumption, environmental pollutants, psychological stress and working on the night shift – might modify

epigenetic patterns.^[13] Epigenetic dysregulations including aberrant methylation, histone modification and microRNA alterations in cancer, as well as neurodegenerative, autoimmune, cardiovascular and other diseases have been reported.^[14] Researchers have also found widespread seasonal gene expression differences in human immunity and physiology.^[15] It is interesting to note that a number of studies have indicated that environmental stress can also promote epigenetic alterations that are transmitted to subsequent generations to induce pathologies.^[16]

Insights from Ayurveda contribute to understanding these processes

According to Ayurveda, matter is composed of five *Mahabhutas* (basic elements) that have the properties of space (*Akasha*), air (*Vayu*), fire (*Tejas*), water (*Jala*) and earth (*Prithivi*). These combine to form three *Doshas*, known as *Vata*, *Pitta* and *Kapha*. The *Doshas* are psychophysiological principles that govern various aspects of the human body. *Vata* is formed from the lighter elements with properties of space and air. *Pitta* is formed from the elements with properties of fire and water. *Kapha* is formed from the heavier elements with properties of water and earth. *Vata* regulates movement and communication, including blood flow, contraction of the heart, breathing, movement of food through the digestive tract and communication of cells through nerve impulses. *Pitta* regulates digestion, metabolism, and transformation, including energy exchange, appetite and endocrine functions. *Kapha* regulates structure and cohesion of the body, including strength, stability, fluid balance and weight. Each individual has a unique ratio of *Vata*, *Pitta* and *Kapha*. This is known as their psychophysiological constitution and correlates with the individual’s phenotype. Ayurveda has an elaborate description of how to maintain good health by following the right principles for the four factors that affect phenotype [Table 1].^[17] The functions which these factors relate to can be summarized as follows:

Lifestyle and behavior

Ayurveda covers the whole lifespan, including prenatal, postnatal, childhood, and lifetime social experiences. It has instructions for daily and seasonal routines, which include the time to go to bed, the time to get up, the time to eat, the time to exercise, the time to study, the time to meditate, and the time for other activities. It also has recommendations for proper behavior, and how to deal with peers, individuals who are younger, and those who are older, in general and in different circumstances. For example, behaviors and attitudes to be maximized include love, compassion and speech that uplifts people. Behaviors and attitudes to be avoided include anger, violence, and harsh or hurtful speech. Advice and guidance should be given to those who are younger, and respect should be given to teachers and elders. These behaviors affect health on the physical level through the release of neuropeptides. Negative emotions release neurochemicals that strain and

Table 1: Factors that affect phenotype

Lifestyle and behavior
Digestion, diet, and nutrition
Stress
Environment

damage the organs, whereas positive emotions release health-promoting chemicals.^[3]

Digestion, diet, and nutrition

Digestion of food is critical to good health according to Ayurveda. The concept of *Agni* or “fire” to digest the consumed food is the basis of proper assimilation of food by the tissues. When *Agni* is weak, food that is incompletely digested results in the toxic buildup of a substance called *Ama*.^[3,18-20] *Ama* may manifest as toxic byproducts of incomplete digestion concentrated in extracellular spaces, or imbalances of homeostatic factors. *Ama* can also include assimilated environmental toxins. As *Ama* is deposited in the tissues and the macro- and micro-channels used for energy flow, it potentially incites the immune system and creates pockets of inflammation. Deposited *Ama* can result in atheroma in arteries, hypercholesterolemia, painful or swollen joints, as well as microscopic barriers to assimilation of nutrients. To minimize the accumulation of *Ama*, recommendations for the proper digestion of food are emphasized in Ayurveda.

Ayurveda has detailed recommendations for diet and nutrition that are personalized according to Ayurvedic constitutional type and other factors.^[3,17,21] The major factors which govern the diet are as follows:

- Taste of the food
- Qualities of the food
- Time of the day, season of the year, and age of the individual
- State of the physiology of the individual
- Geographic location.

The taste and qualities of foods affect the *Doshas* (*Vata*, *Pitta*, and *Kapha*) in specified ways, and thereby affect the psychophysiological constitution in either a healthy or unhealthy manner. The time of day, season of the year, and age of the individual are classified according to the *Doshas* and thereby influence the psychophysiological constitution and the choice of foods that are healthy or unhealthy in that particular situation. Geographic location is also taken into consideration.

Stress

In addition to the major stressful events in life, small conflicts and disputes that occur in day-to-day living can negatively impact health, and hinder progress and evolution. To manage stress, Ayurveda recommends proper living and proper knowledge of life, Yoga, breathing exercises, meditation, whole-body massage, Ayurvedic psychotherapy, and herbs.

Environment – near and far

Ayurveda addresses the effects of near and far environments. Near environment refers to the place of residence and the effects of the physical structure of the house and workplace. There are recommendations regarding areas to live, the architecture of the house, effects of the house where you live and the building where you work, avoidance of toxic exposure, and how to maximize beneficial effects. Far environment refers to the cosmic bodies – the planets, moon, and stars.

Recommendations address their influence and how they affect the physiology.^[22]

Ayurvedic Pharmacopeia

Ayurvedic texts document the extensive use of botanicals for improving health and immunity. Ayurvedic botanicals include natural active products such as flavonoids, terpenes, and polyphenols that may also regulate epigenetic mechanisms without toxicity.^[3,5,23-25] More research into this area is needed to understand this level of regulation of epigenetics and of mechanisms of health by Ayurvedic herbs.

Underlying Philosophy

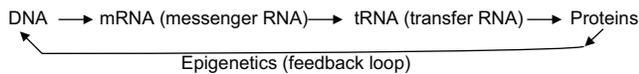
Ayurveda and the ancient *Vedic* knowledge of India provide a philosophical understanding of the order and impulses of nature. According to *Vedic* science, the human being consists of two aspects: the neverchanging and the everchanging. The physical body, and the inner faculty or working consciousness, are relative and constantly changing. The deep inner Self, or pure Consciousness, is absolute and never changes.^[26] The Absolute is referred to as *Sat-Chit-Anand*, which translates as “Pure existence-Pure consciousness-Bliss.” This deep inner Self is the silent source of all knowledge, intelligence, and creativity, and all natural laws that govern existence.

The Absolute pertains to the overall order and intelligence of nature. The Relative aspect is called *Prakriti* and refers to the impulse or initiation of expression of existence in material form. This correlates with how gene expression leads to material existence. DNA by itself is silent, but holds the possibility of all or any genes to be expressed; this correlates with the Absolute, which is the silent source of creation. Only through external signals from other cells or the tissue microenvironment are genes expressed, and cells continue to adapt to their external changing environment. These external signals correlate with the way in which *Prakriti* initiates the material expression of existence.

One example of how Ayurveda and *Vedic* knowledge correlate with the current scientific understanding of the physiology is in the process of conception. Every living creature starts life as one single cell. The fertilized embryo is derived from the union of two germ cells, one from the male parent and the other from the female parent. As long as the two cells remain separate, no reproduction occurs. This correlates with the Absolute remaining silent and *Prakriti* being required to initiate the expression of existence in material form. The DNA represents the material equivalent of the Absolute, which is the source of everything but does not do anything to create the universe.^[27] This corresponds with a saying from the ancient Ayurvedic text *Charaka Samhita*: “*Purusho 'yam loka sannidah*” which translates as “Man is a miniature universe.”^[28]

Another example of the correlation between Ayurvedic knowledge and current scientific understanding is in how the information in the DNA becomes the material of the body.

DNA – the genetic code of the individual – like the Absolute has all the knowledge of the individual but only expresses part of its knowledge. During the process of expression, the two strands of DNA separate to form messenger RNA (mRNA) during the transcription process, and then transfer RNA (tRNA) facilitates the translation process to create amino acids that combine to form proteins. The DNA strands open and close and in essence, DNA does not do anything, i.e., does not change in its structure, and yet creates the expressed part which becomes the phenotype.^[6] A feedback loop then influences the subsequent expression of DNA; this is the influence of epigenetics – this is how lifestyle, diet and digestion, stress, and environment affect health. The whole process is simplified and summarized as follows:



The *Vedic* texts describe the process of material creation as arising from an undifferentiated state of unity or pure Consciousness known as *Samhita*. From this underlying unity arises a tripartite diversity resulting in an awareness of existence and in the material creation, i.e., *Rishi* – knower, *Devata* – process of knowing (activity), and *Chhandas* – the known (final product).^[3] This correlates with the process of DNA expression. DNA contains the totality of information and correlates with *Samhita* or unity; mRNA carries the information and correlates with *Rishi*, the knower; tRNA facilitates the translation process to create amino acids and correlates with *Devata*, activity; and the amino acids and proteins correlate with *Chhandas*, the final product.

The DNA (genetic code) does not change (except by toxic and radiation injury, etc.); likewise, the Absolute does not change. The phenotype – the expressed value of DNA from its different parts – is dynamic and always changing (the Relative value of life). The phenotype sends messages back to the DNA in a feedback loop that can change the expression of the DNA code by turning on or turning off genes. These are the epigenetic functions of DNA methylation and alterations in the histones and chromatin that occur in response to environmental signals. The phenotype – the genes that are expressed – is dynamic and always changing. These two together, genes and phenotype, represent Absolute and Relative in material expression, with Absolute expressing different knowledge through DNA and manifesting as different phenotypic individuals.

Meditation

Ayurveda is a comprehensive system of health care that addresses physical, mental, and spiritual well-being. According to *Vedic* science, the deep inner Self (pure Consciousness) activates the inner faculty (working consciousness), which in turn activates the physical body. A self-referral feedback loop is provided by meditation, in which a conscious connection is made with the deep inner Self.^[26] This correlates with the epigenetic feedback loop in the cells of the body. In meditation,

the feedback loop to the deep inner Self (the seat of knowledge, like DNA) provides inner peace and bliss, which removes the accumulated stresses of life and improves overall health. In the process of meditation, when the mind transcends the senses, intellect, and ego, and reaches the deep inner Self – pure Consciousness – it starts imbibing the properties of pure Consciousness – peace, bliss, energy, and creativity – and these are expressed in the daily activities of life.

Conclusion

Ayurveda restores the innate intelligence of the body and awareness for healing. Homeostatic factors are ingrained in the blueprint for life. Meddling with the laws of nature can result in detours on the path to optimal health. Ayurvedic therapies can affect both the genetic and phenotypic expression of life. Research efforts into Ayurvedic modalities and herbal preparations should include how epigenetic mechanisms are altered in target tissues or in the immune cells. Potential new pathways of cellular and molecular functioning may be discovered in the process of evaluating Ayurvedic approaches. Ayurveda can be appreciated through the science of epigenetics, covering the manifested expression of life, and how to maintain and improve the health of the individual. The epigenetic factors in life affect the phenotype in a positive or negative way, and indirectly affect the genetic expression in a positive or negative way, which can be transmitted to the progeny. Ayurveda covers both aspects of life – genetic and phenotypic – and is a comprehensive, holistic, and personalized system of health care.

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Conflicts of interest

There are no conflicts of interest.

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हिन्दी सारांश

आयुर्वेद: जीवन विज्ञान, आनुवंशिकी और इपीजेनेटिक

हरि शर्मा

आयुर्वेद एक प्राचीन चिकित्सा प्रणाली है जो कि भारत में वैदिक काल से विद्यमान है। आयुर्वेद सिद्धांतों का प्रलेखीकरण चरक संहिता एवं सुश्रुत संहिता जैसे चिकित्सीय ग्रंथों में प्राप्त होता है, जिसमें शरीर क्रिया विज्ञान, परस्पर संलग्न शरीर के संस्थान, मानव शरीर एवं प्रकृति में विभिन्नता, शल्य क्रिया, औषध प्रयोग तथा स्वास्थ्य संवर्धक विषय पर जानकारी प्राप्त होती है। आयुर्वेद का अनुवाद "जीवन का विज्ञान", "आयुस् = लाइफ, और वेद = ज्ञान / विज्ञान" के रूप में किया गया है और इस विज्ञान के सिद्धांत और उपचार पद्धतियाँ समय के साथ खरी उतरी हैं। पश्चिमी चिकित्सा शोधकर्ताओं द्वारा आयुर्वेद को स्वीकृत करने के लिए, आधुनिक परंपरा के संदर्भ में इस पारंपरिक चिकित्सा पद्धति को समझना चाहिए। अतः आयुर्वेदिक दृष्टिकोणों का समर्थन करने वाली शारीर क्रिया विज्ञान (फिजियोलॉजी) के वर्तमान सिद्धांतों के अन्वेषण की आवश्यकता है। इस प्रकार, प्रस्तुत शोधपत्र में आयुर्वेद तंत्र को इपीजेनेटिक के सिद्धांत के आधार पर समझने का एक प्रयास है।