

Functional perspectives on Tridosha and endocrine regulation: An integrative review

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Abstract

The principles of *Vāta*, *Pitta*, and *Kapha*, collectively termed *Tridosha* in *Āyurveda*, represent fundamental regulatory mechanisms governing physiological balance. These concepts offer a systems-based framework for understanding complex biological functions, which may be interpretatively compared with modern endocrine regulation.

Methods: A narrative and interpretative review was conducted using classical Ayurvedic texts, including *Bṛhatrayī* and *Laghutrayī*, along with contemporary literature on endocrinology. Relevant descriptions of *Doshā*, *Agni*, and *Dhātu* were analyzed and compared with established mechanisms of hormonal regulation.

Results: The analysis suggests that *Vāta Dosha* (governed by movement and rapid change) shows parallels to the HPA axis (CRH → ACTH → cortisol) and neurohormonal feedback mechanisms (pulsatile GnRH → LH/FSH), which mediate rapid stress responses and physiological adaptation. *Pitta Dosha* (associated with heat and transformation) aligns with the HPT axis and thyroid hormones that regulate basal metabolic rate, thermogenesis, and cellular metabolism, as well as insulin-mediated metabolic control. *Kapha Dosha* (associated with structure, stability, and fluid balance) corresponds with the GH-IGF-1 axis, which promotes anabolic growth and tissue development, and with fluid homeostasis mechanisms such as ADH-mediated water reabsorption. These associations reflect functional parallels rather than direct anatomical or biochemical equivalence.

Conclusion: Ayurvedic Dosha concepts and endocrine functions appear to share thematic overlaps. Further interdisciplinary research is required to validate these conceptual correlations and explore their application in understanding health and disease.

Keywords: Ayurveda; *Vata*; *Pitta*; *Kapha*; Endocrine system; Hormones; Physiology; *Dosha Gati*

1. Introduction

Āyurveda, the traditional system of medicine, conceptualizes the human body as a dynamic and functionally integrated entity governed by the principles of *Vāta*, *Pitta*, and *Kapha*, collectively referred to as *Tridoṣha*. These *Dosha* are not anatomical structures but represent fundamental regulatory factors that maintain physiological balance (*Sāmya Avasthā*) and overall health (*Svasthya*). Classical texts emphasize that the equilibrium of *Doshā*'s, along with proper functioning of *Agni*, *Dhātu*, and *Mala*, constitutes the basis of health.

From a contemporary perspective, physiological regulation is largely mediated by the endocrine system, wherein hormones act as biochemical messengers coordinating diverse processes such as metabolism, growth, reproduction,

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and adaptation to internal and external stimuli. These hormones, secreted by specialized endocrine glands, function through complex feedback mechanisms to maintain systemic homeostasis.

A comparative and interpretative perspective suggests that certain functional parallels may be drawn between *Tridosha* and endocrine regulation. *Vāta*, characterized by *Chala* (mobility) and *Sūkṣma* (subtlety), governs movement, communication, and impulse transmission, which may be functionally associated with neuroendocrine signaling and regulatory pathways. *Pitta*, defined by *Uṣṇa* (heat) and *Tikṣṇa* (intensity), is responsible for transformation and metabolic activity, and may be correlated with enzymatic processes and hormone-mediated biochemical reactions. *Kapha*, possessing *Guru* (heaviness) and *Sthira* (stability), contributes to structural integrity, growth, and tissue nourishment, which can be interpretatively linked with anabolic processes and hormonal regulation of tissue maintenance.

It is important to emphasize that these correlations are conceptual and should not be construed as direct equivalence between Ayurvedic principles and specific endocrine structures or hormones. Rather, they represent an attempt to understand traditional physiological concepts through the lens of modern scientific frameworks.

In this context, the present review aims to critically analyze descriptions of *Dohṣa* physiology from classical Ayurvedic compendia, including *Bṛhatṭrayī* and *Laghutrayī*, and to explore their possible functional relationships with endocrine mechanisms. By integrating traditional knowledge with contemporary endocrinology, this study seeks to provide a broader and more comprehensive understanding of physiological regulation and its implications for health and disease.

2. Review of Literature

2.1. Dosha Physiology in Ayurveda

2.1.1. Vata Dosha

Vata governs all movements (*Chala Guna*) and communications within the body (*Vega Pravartaka*), such as nerve impulses and secretions (*Srotogati*). The *Charaka Samhita* (Sutrasthana 12/8) emphasizes *Vata*'s role as the initiator of functions (*Praspanadana*), which aligns with neuroendocrine regulation [1, 10]. *Vāta Doṣha* is considered the principal regulator of all physiological activities in *Āyurveda*, owing to its inherent qualities such as *Chala* (mobility), *Sūkṣma* (subtlety), *Rūkṣa* (dryness), and *Laghu* (lightness). It is responsible for the initiation and propagation of all bodily functions, as indicated in classical texts:

The fundamental functions of *Vāta* include *Praspanadana* (initiation of activity), *Gati* (movement), and *Vega Pravartana* (propulsion), which collectively ensure proper coordination of physiological processes. It governs the movement of substances and impulses through various *Srotas*, thereby maintaining internal communication and functional integration within the body. The functional specificity of *Vāta* is further understood through its subtypes. *Prāṇa Vāta* regulates higher centers and vital functions, *Udāna Vāta* governs expression and upward movement, *Samāna Vāta* coordinates digestion and metabolic processes in association with *Agni*, while *Vyāna Vāta* is responsible for circulation and distribution throughout the body.

Thus, *Vāta Doṣha* serves as the fundamental force responsible for initiating, regulating, and coordinating all dynamic physiological activities, maintaining systemic harmony in accordance with Ayurvedic principles.

Mechanism: The hypothalamus-pituitary-adrenal (HPA) axis plays a central role in regulating hormonal secretions in response to stress and circadian rhythms, which closely mirrors *Vata*'s dynamic nature (*Gati*). When the body perceives stress or experiences changes in circadian rhythms, the hypothalamus releases corticotropin-releasing hormone (CRH), which stimulates the pituitary gland to secrete adrenocorticotrophic hormone (ACTH). ACTH, in turn, stimulates the adrenal glands to release cortisol, the primary stress hormone. This physiological process is highly dynamic and involves rapid neurotransmitter release and action potentials, which align with the *Chala Guna* of *Vata*—the quality of movement and variability. The stimulation of the endocrine glands via these neurotransmitters and action potentials reflects *Vata*'s inherent characteristics of initiation and change. The secretion of cortisol plays a critical role in the body's stress response, enhancing metabolic functions, regulating blood sugar, and preparing the body for "fight or flight" reactions. Thus, the HPA axis operates with a level of variability and responsiveness that aligns with the *Vata dosha*'s role in maintaining physiological adaptability and homeostasis in response to environmental changes [1, 16].

2.1.2. Pitta Dosha

Pitta is described as the controller of metabolism (*Agni*), transformation (*Parinama*), and enzymatic activities (*Pachana*). It regulates *Daha* (burning processes) and maintains *Ushma* (body temperature) [2].

Mechanism: Thyroid hormones (T3 and T4), secreted by the thyroid gland under the influence of the hypothalamus-pituitary-thyroid (HPT) axis, play a crucial role in Bhautika Agni (tissue metabolism). T3 enters target cells and binds to nuclear receptors, triggering gene transcription that enhances various metabolic processes. These include increasing the Basal Metabolic Rate (BMR) by stimulating mitochondrial activity, enhancing protein synthesis and catabolism, promoting lipolysis for energy, and boosting carbohydrate metabolism by enhancing glucose absorption and glycolysis. The heat produced through these processes aligns with *Pitta's Ushma* (heat) and *Pachana* (digestive functions). Similarly, glucocorticoids regulate metabolism by promoting gluconeogenesis, fat breakdown, and protein mobilization, supporting *Jatharagni* (digestive fire) during stress or fasting. Acute stress increases *Agni*, but chronic stress and excessive cortisol can weaken digestive fire (*Mandagni*) and impair digestion [2, 12, 14].

2.1.3. Kapha Dosha

Kapha governs stability (*Sthira Guna*), structural integrity (*Sthayi Dhatu*), and nourishment. It is responsible for *Brimhana* (anabolism) and fluid balance (*Sneha*).

Mechanism: *Kapha* plays a crucial role in regulating anabolic hormones, such as growth hormone (GH) and insulin-like growth factor-1 (IGF-1), which are responsible for promoting *Vridhhi* (growth) and *Dhatu Poshana* (tissue nourishment). GH, released by the pituitary gland, stimulates the liver to produce IGF-1, which then acts on various tissues to promote cell growth, protein synthesis, and the regeneration of tissues, aiding in overall body growth and development. This process is aligned with *Kapha's* nurturing and building nature, as it contributes to the formation of body tissues and stability. Additionally, antidiuretic hormone (ADH) regulates fluid retention by acting on the kidneys to promote water reabsorption, reducing urine output. This mechanism corresponds with *Kapha's Sneha* (moisture-retaining) property, which is associated with maintaining hydration and ensuring the body retains essential fluids for proper function. Through the actions of GH, IGF-1, and ADH, *Kapha* supports the growth, nourishment, and hydration necessary for maintaining bodily health and homeostasis [13, 17].

2.2. Dosha-Endocrine Mechanisms in Modern Physiology

Table 1 *Dosha*- Endocrine Correlation

Endocrine Gland / Axis	Major Hormones	Relevant Ayurvedic Concept (Functional Correlation)	Physiological Perspective (Modern Science)
Hypothalamus–Pituitary Axis	ACTH, GH, TSH	Regulation through <i>Vata</i> (especially <i>Prana & Udana Vata</i>) governing coordination, signalling, and initiation of systemic functions; supported by <i>Satva</i> in higher control	Central neuroendocrine integration; regulation of peripheral endocrine glands; stress response coordination
Thyroid Gland	T3, T4, Calcitonin	<i>Pitta (Agni, especially Dhatvagni)</i> is responsible for metabolic transformation and heat production	Regulation of basal metabolic rate, oxygen consumption, and thermogenesis
Adrenal Glands	Cortisol, Aldosterone	<i>Pitta</i> (particularly <i>Pachaka Pitta</i>) in metabolic adaptation; <i>Vata</i> involvement in stress response and rapid systemic adjustments	Stress response, energy mobilization, maintenance of blood pressure, and electrolyte balance
Pancreas	Insulin, Glucagon	<i>Kapha (Brimhana, Tarpana)</i> for anabolic processes; <i>Pitta (Pachaka)</i> in digestion and metabolic conversion	Regulation of blood glucose levels and overall energy homeostasis
Gonads (Testes/Ovaries)	Testosterone, Estrogen	Shukra Dhatu and its nourishment, governed by <i>Kapha</i> (growth, stability) and <i>Pitta</i> (transformation, maturation)	Reproductive function, secondary sexual characteristics, and gametogenesis

Pineal Gland	Melatonin	Regulation linked with <i>Vata</i> (especially <i>Prana Vata</i>) governing rhythmicity and neural coordination; influence on Nidra (sleep)	Regulation of circadian rhythm and sleep–wake cycle
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2.3. Mechanisms of Imbalance *Dosha* in Endocrine Disorders

- ***Vata* Imbalance:** *Vata Prakopa* causes irregular neuroendocrine signals, leading to adrenal insufficiency, hypothyroidism, and hormonal fluctuations (*Majja Dhatu Kshaya*) [10, 16].
- ***Pitta* Imbalance:** *Pitta Vriddhi* overstimulates metabolism, manifesting as hyperthyroidism, insulin resistance, and excess cortisol release [12].
- ***Kapha* Imbalance:** *Kapha Vriddhi* enhances anabolic states, resulting in obesity, hypothyroidism, and fluid retention (*Medoroga*) [13, 18].

3. Discussion

The physiological mechanisms linking the Ayurvedic *doshas* to endocrine regulation highlight how *Vata*, *Pitta*, and *Kapha* influence hormonal and metabolic processes. *Vata* regulates neuroendocrine functions, affecting cortisol production and stress response, with imbalances leading to conditions like adrenal insufficiency. *Pitta* governs metabolism through thyroid hormones, impacting energy production and thermogenesis, where imbalances can cause hyperthyroidism or hypothyroidism. *Kapha* supports growth and tissue nourishment through growth hormone and fluid balance via antidiuretic hormone, with imbalances leading to fluid retention or dehydration. Maintaining *dosha* equilibrium is crucial for optimal endocrine function and metabolic health, as *Dosha* imbalances disrupt these mechanisms, contributing to endocrine disorders [17, 19].

4. Conclusion

This review highlights the valuable intersection between Ayurvedic Tridosha theory and modern endocrinology, offering a novel perspective on the physiological mechanisms of hormone regulation. By mapping the roles of *Vata*, *Pitta*, and *Kapha* to key endocrine processes, it becomes evident that Ayurveda provides a holistic framework for understanding hormonal balance and metabolism. By evaluating an individual's *dosha* imbalances, Ayurvedic practitioners can adapt interventions to restore harmony and optimize hormonal regulation. This treatment strategy offers a promising complement to modern medicine, potentially improving outcomes in conditions such as thyroid imbalances, adrenal dysfunction, and metabolic disorders. Ultimately, the combination of Ayurvedic wisdom with modern endocrinology enriches our understanding of the endocrine system, demonstrating Ayurveda's relevance and effectiveness in managing health through a personalized, holistic lens.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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