

Tridosha, Systems Biology, and the Physiome: Bridging Ayurvedic Principles with Modern Integrative Models

KID: 20250321 | Mr Rohit Marathe



Ayurveda, one of the world's oldest systems of natural healing, is a vital part of India's cultural and scientific heritage. Rooted in centuries of wisdom, it offers a holistic approach to health by balancing the body, mind, and spirit through natural remedies, diet, and lifestyle practices. Even today, Ayurveda remains highly relevant as people across the globe seek sustainable and preventive healthcare solutions, turning to its time-tested methods for wellness, immunity, and harmony in an age of fast-paced living and modern health challenges.

Ayurveda views the human system through the framework of the tridoshas—Vata, Pitta, and Kapha—symbolizing movement and regulation, metabolic transformation, and growth and support, respectively. This stands in contrast to modern medicine's reductionist, bottom-up perspective, which explains physiology by linking processes across scales from genes to organs. At the heart of Ayurveda lies the principle that health emerges from the balance of the tridoshas, while their imbalance gives rise to disease.

Previous research in this area has hypothesized that tridoshas may map to biochemical reaction pairs such as oxidation/reduction, exothermic/endothermic, and hydration/dehydration. It has also been suggested that the five sub-doshas of each dosha could correspond to major organ systems, including the epithelial, digestive, cardiovascular, and central nervous systems. Further work has conceptualized tridosha interdependencies as a network, with health representing an ideal network state and disease arising from its disruption. Despite these efforts, the precise correspondence between tridoshas, sub-doshas, and modern physiological parameters remains elusive.

With this background, we turn to Systems Biology, which is an interdisciplinary field that studies biological processes as integrated networks of genes, proteins, cells, and organs rather than isolated parts. By combining experimental data with computational modeling, it seeks to understand how complex interactions give rise to health, disease, and emergent behaviors in living systems.

Systems biology provides the foundation for understanding the Physiome, a term derived from "physio" (life) and "ome" (as a whole). The physiome refers to a quantitative and integrated description of the functional state of an individual or species, capturing the physiological dynamics of the intact organism. It is built on structural and informational layers such as the genome, proteome, and morphome. Broadly, the physiome seeks to map relationships from genome to whole organism and from functional behavior to gene regulation. Within the Physiome Project, this vision is realized through integrated models of biological components—ranging from organs and cell systems to biochemical and endocrine networks.

The perspectives of Ayurveda resonate well with these contemporary approaches in Systems Biology and the Physiome project. Just as tridosha theory emphasizes balance and interdependence, systems-level models highlight the importance of dynamic interactions and homeostasis across physiological scales, suggesting a conceptual bridge between traditional Ayurvedic frameworks and modern integrative biology.

Building on these ideas, our research seeks to model the tridoshas as an unknown triad of vectors spanning a high-dimensional space of physiological systems. Within this tridosha-based coordinate system, even subtle shifts may produce nonlinear effects across multiple physiological parameters. Health, in this view, corresponds to stable subspaces, while disease arises from deviations away from them. The precise transformation between this Ayurvedic coordinate system and the frameworks of modern physiology is not clearly defined. Our work seeks to bridge this gap by applying physiological modeling alongside methods from dynamical systems, linear algebra, and machine learning. We strongly believe that this will address the challenge of articulating Ayurvedic efficacy in contemporary biomedical language.

References

- Mahdihassan, S., 1986. A scientific interpretation of the tridosha doctrine of humorology. *Ancient science of life*, 6(1), p.42.
- Hankey, A., & Kale, A. (2023). Integrative biology for integrative medicine: A complete approach. *Journal of Ayurveda and Integrative Medicine*, 14(6), 100831
- Jayasundar, R., 2017. If systems approach is the way forward, what can the ayurvedic theory of tridosha teach us?. *CURRENT SCIENCE*, 112(6), p.1127.
- Noble, Denis. "Systems Biology, the Physiome Project and Oriental Medicine." *The Journal of Physiological Sciences* 59, no. 3 (2009): 249–51.
- Leem, Chae Hun. "Perspectives of Physiome Research." *Integrative Medicine Research* 5, no. 1 (2016): 37–40.

“Ayurveda views the human system through the framework of the tridoshas—Vata, Pitta, and Kapha—symbolizing movement and regulation, metabolic transformation, and growth and support, respectively”

Mr Rohit Marathe

Research Scholar

Dept of Heritage Science and Technology