

THE AGNI-GUT MICROBIOME AXIS: BRIDGING AYURVEDIC CONCEPTS WITH CONTEMPORARY MICROBIOME SCIENCE – A NARRATIVE REVIEW

***¹Dr. Akshay B. Salunke, ²Dr. V. E. Gogate**

***¹PG (Sch), Dept. of Kayachikitsa, GAC, Nanded.**

²(Professor & HOD) Dept. of Kayachikitsa, GAC Nanded.

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***Corresponding Author**

Dr. Akshay B. Salunke

PG (Sch), Dept. of Kayachikitsa,
GAC, Nanded.



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ABSTRACT

Digestion and metabolism are essential processes that regulate immune function, metabolic balance, and overall health. Recent research has identified the gut microbiome as a key regulator of these functions, while Ayurveda recognizes Agni as the fundamental principle governing digestion and metabolism. Despite their different origins, both concepts share important functional similarities, providing a valuable basis for integrating Ayurvedic knowledge with modern microbiome science. This narrative review examines the relationship between the Ayurvedic concept of Agni and the modern understanding of the gut microbiome. Evidence from classical Ayurvedic texts and contemporary biomedical literature was reviewed to explore their roles in digestion, metabolism, immune regulation, and overall health. A qualitative

comparison was undertaken to identify common functional principles while recognizing that the two concepts represent complementary rather than identical biological frameworks. The available evidence suggests strong functional parallels between Samagni and a healthy gut microbiome, both supporting efficient digestion, nutrient metabolism, immune balance, and overall physiological homeostasis. Conversely, Agnimandya and Ama resemble the modern concepts of gut dysbiosis and metabolic endotoxemia, which are associated with chronic inflammation and metabolic dysfunction. Ayurvedic lifestyle practices, including balanced diet, regular daily routines, and stress management, are also recognized as important factors influencing gut microbial health. These findings indicate that Agni and the gut microbiome

offer complementary perspectives on metabolic regulation and systemic health. Integrating Ayurvedic concepts with modern microbiome research may provide new insights for preventive, personalized, and integrative healthcare.

KEYWORDS: Agni; Ayurveda; Gut Microbiome; Ama; Integrative Medicine, Metabolism; Dysbiosis.

INTRODUCTION

Digestion and metabolism are fundamental physiological processes essential for nutrient assimilation, energy production, immune regulation, and overall health. Recent advances in biomedical research have redefined the gut as a metabolically active ecosystem, with the gut microbiome playing a central role in regulating metabolism, immune homeostasis, and systemic well-being.^[1]

The gut microbiome is an essential contributor to carbohydrate, protein, and lipid metabolism and is involved in the production of bioactive metabolites, including short-chain fatty acids. It also plays a crucial role in maintaining immune balance and regulating inflammatory processes. Disturbances in microbial composition, known as dysbiosis, have been associated with obesity, type 2 diabetes mellitus, inflammatory bowel disease, and several other chronic metabolic disorders.^[2] These observations highlight that digestion is a complex, interactive process influenced by the host, gut microorganisms, dietary habits, and environmental factors, ultimately contributing to overall systemic health.^[3]

In Ayurveda, Agni is regarded as the cornerstone of digestion, metabolism, and all physiological transformations within the body. It plays a vital role in the proper digestion and assimilation of food, nourishment of tissues (Dhatu Poshana), maintenance of strength (Bala), complexion (Varna), vitality (Ojas), and overall health.^[4] Thus, balanced Agni is considered essential for sustaining normal physiological functions.

Conversely, weakened Agni (Agnimandya) leads to incomplete digestion and the accumulation of Ama, an incompletely metabolized substance believed to initiate disease by disturbing normal bodily processes.^[5] This Ayurvedic concept closely parallels modern understanding of gut dysbiosis, metabolic endotoxemia, impaired intestinal barrier integrity, and chronic low-grade inflammation.^[6]

The Ayurvedic concept of Agni shares several functional similarities with the modern concept of the gut microbiome. Both are essential for maintaining digestive efficiency, metabolic balance, and overall physiological health, and both are significantly influenced by dietary habits, lifestyle, and environmental factors. These shared features provide a meaningful basis for integrating Ayurvedic concepts with contemporary microbiome research to better understand the mechanisms underlying health and disease. Accordingly, this review examines the conceptual association between Agni and the gut microbiome, focusing on their contributions to metabolism, inflammatory regulation, and systemic health.

METHODS

This narrative review was conducted to explore the conceptual relationship between the Ayurvedic concept of Agni and the gut microbiome in the context of digestion, metabolism, immune regulation, and systemic health. Classical Ayurvedic texts and authoritative commentaries were reviewed alongside peer-reviewed biomedical literature retrieved from databases such as PubMed and Google Scholar, focusing on gut microbiome, host–microbe interactions, metabolism, and inflammation.

A qualitative comparative approach was used to identify functional similarities between Ayurvedic and contemporary biomedical concepts. The review emphasizes conceptual convergence rather than direct biological equivalence and aims to integrate traditional Ayurvedic knowledge with current microbiome science. As this is a narrative review, no PRISMA methodology, primary data collection, experimental interventions, or statistical analyses were undertaken.

Relationship Between Agni and Gut Microbiome

Ayurveda describes Agni as the fundamental force responsible for digestion, metabolism, and physiological transformation at multiple levels. Jatharagni carries out the primary digestion of food, Bhutagni converts nutrients into forms suitable for the body, and Dhatvagni governs metabolic activities within individual tissues. The coordinated action of these forms of Agni supports proper nutrient assimilation, tissue nourishment, and metabolic balance.^[7]

In modern medicine, the gut microbiome is recognized as a key regulator of digestive and metabolic functions. By producing bioactive metabolites and participating in microbial fermentation, the gut microbiota influences nutrient utilization, energy metabolism, immune

homeostasis, and inflammatory pathways, thereby contributing to overall physiological health.^[8]

Functionally, Samagni may be compared with microbial eubiosis, as both are associated with efficient digestion, balanced metabolism, and optimal immune function. Conversely, Agnimandya shares similarities with gut dysbiosis, where disturbed microbial balance leads to impaired digestion, metabolic abnormalities, chronic inflammation, and increased disease susceptibility.^[9]

These functional parallels indicate that the Ayurvedic concept of Agni and the modern understanding of the gut microbiome provide complementary perspectives on metabolic regulation. Integrating these concepts may strengthen the scientific understanding of digestive health and offer new directions for research in preventive, personalized, and integrative medicine.

Role in Metabolic Regulation

Agni and the gut microbiome are both fundamental regulators of metabolic function, influencing the digestion and utilization of carbohydrates, proteins, and lipids. In contemporary biomedical research, the gut microbiome is recognized as a metabolically active ecosystem that ferments dietary fibers and generates short-chain fatty acids (SCFAs), such as acetate, propionate, and butyrate. These microbial metabolites contribute to energy production, insulin sensitivity, lipid metabolism, immune regulation, and multiple host metabolic signaling pathways.^[10]

According to Ayurveda, Agni is the key determinant of digestion, biotransformation, and tissue metabolism. It regulates Ahara Paka (food digestion) and Dhatu Paka (tissue metabolism), thereby facilitating Dhatu Poshana (tissue nourishment), efficient nutrient assimilation, and maintenance of metabolic equilibrium. A decline in Agni disrupts these processes, leading to impaired digestion, poor tissue nutrition, and metabolic imbalance.^[11]

Functionally, Samagni may be compared with a balanced gut microbiome, as both support efficient digestion, optimal nutrient utilization, and metabolic homeostasis. In contrast, impaired Agni and microbial dysbiosis are associated with defective digestion, altered glucose and lipid metabolism, and an increased predisposition to metabolic disorders.

Overall, these similarities indicate that the concepts of Agni and the gut microbiome provide complementary perspectives on metabolic regulation. While these correlations are conceptual rather than direct biological equivalents, they offer a valuable framework for future research in integrative, preventive, and personalized medicine.

DISCUSSION

The present review demonstrates meaningful conceptual parallels between the Ayurvedic concept of Agni and the contemporary understanding of the gut microbiome, highlighting their shared roles in regulating digestion, metabolism, and overall physiological health.

Integrative Perspective of Agni and the Gut Microbiome

According to Ayurveda, Agni is the fundamental principle that governs digestion, nutrient transformation, and metabolic activities throughout the body. It functions through Jatharagni, which performs primary digestion; Bhutagni, which facilitates elemental transformation; and Dhatvagni, which regulates tissue metabolism. The coordinated activity of these forms of Agni ensures efficient nutrient assimilation, tissue nourishment, and maintenance of metabolic equilibrium.

Likewise, modern biomedical science identifies the gut microbiome as a major contributor to metabolic regulation, immune homeostasis, and inter-organ communication. Through the production of microbial metabolites and complex host–microbe interactions, the gut microbiota influences not only gastrointestinal function but also systemic physiological processes. Viewed together, Agni and the gut microbiome provide complementary frameworks for explaining how efficient digestion and metabolic balance contribute to health and how their disruption may predispose individuals to chronic metabolic disorders.

Ama and Microbial Dysbiosis: A Conceptual Correlation

According to Ayurveda, Ama is an incompletely metabolized substance produced due to weakened Agni. It is regarded as a key pathogenic factor that obstructs Srotas (body channels), interferes with normal tissue metabolism, and promotes the onset of various diseases through systemic dysfunction and inflammatory changes.

In modern biomedical science, gut dysbiosis refers to an imbalance in the intestinal microbial community that results in the generation of endotoxins and pro-inflammatory metabolites, including lipopolysaccharides. These harmful products disrupt intestinal barrier integrity,

induce chronic low-grade inflammation, and are associated with obesity, insulin resistance, cardiovascular diseases, and other metabolic disorders.

Despite their different theoretical origins, Ama and gut dysbiosis demonstrate significant conceptual similarities, particularly with respect to impaired metabolism, accumulation of harmful metabolites, and persistent inflammation. These shared functional features support an integrative interpretation of disease mechanisms and encourage further interdisciplinary research linking Ayurvedic concepts with modern microbiome science.

Modulators of Agni and the Gut Microbiome: Lifestyle Convergence

In Ayurveda, the functional state of Agni is closely influenced by lifestyle and behavioral factors. A wholesome diet, adherence to Dinacharya (daily routine) and Ritucharya (seasonal regimen), proper sleep, and mental balance are considered essential for maintaining healthy digestion and metabolism. Conversely, unhealthy dietary habits, incompatible food combinations, irregular routines, sleep disturbances, and chronic stress are believed to weaken Agni and predispose to disease.

Current biomedical evidence demonstrates similar observations, showing that diet, meal timing, circadian rhythm, sleep patterns, and psychological stress are key regulators of gut microbial composition and activity. Disruption of circadian rhythm can adversely affect microbial function and metabolic signaling, increasing susceptibility to metabolic disorders.^{[12] [13]} In addition, chronic stress alters gut microbial balance and intestinal barrier integrity through neuroendocrine pathways. These shared observations indicate that Ayurvedic lifestyle recommendations and modern microbiome research converge in recognizing lifestyle as a fundamental determinant of metabolic and systemic health.

Ayurvedic Interventions and Microbiome Modulation

Ayurvedic management primarily focuses on maintaining and restoring Agni to achieve optimal digestion, metabolism, and overall health. Therapeutic approaches such as Deepana–Pachana, personalized dietary modifications, and Shodhana (purification therapies) are employed to remove Ama, enhance digestive capacity, and restore metabolic balance. Although these principles originated before the discovery of the gut microbiome, growing scientific evidence indicates that they may positively influence gut microbial ecology and function.^[14]

Herbs commonly used in Deepana–Pachana contain phytochemicals with prebiotic, antimicrobial, and anti-inflammatory activities. Similarly, Ayurvedic dietary guidelines that promote wholesome, seasonal, and easily digestible foods may support a healthy and diverse gut microbiota. Shodhana therapies may further influence gut physiology by improving intestinal motility, bile flow, and microbial metabolite profiles. Collectively, these observations suggest that the beneficial effects of Ayurvedic therapies may be partly explained through their influence on host–microbiome interactions.

Future Directions and Research Imperatives

While the proposed relationship between Agni and the gut microbiome is conceptually compelling, further scientific validation is essential. Future investigations should focus on well-structured clinical and experimental studies employing modern technologies such as metagenomics, metabolomics, inflammatory biomarkers, and chronobiological analyses to better understand the biological effects of Ayurvedic interventions on the gut microbiome.

Prospective studies evaluating the impact of Ayurvedic dietary guidelines, lifestyle modifications, and therapeutic approaches on microbial composition, metabolic regulation, and overall health are also warranted. Generating such evidence will facilitate the translation of classical Ayurvedic principles into measurable scientific outcomes and promote the integration of Ayurveda with contemporary biomedical research. This interdisciplinary approach may provide new opportunities for advancing preventive, personalized, and integrative medicine.

CONCLUSION

The Ayurvedic concept of Agni offers a comprehensive understanding of digestion, metabolism, and overall physiological well-being. Likewise, growing evidence from gut microbiome research highlights the critical role of digestive homeostasis in maintaining metabolic and immune health. The conceptual overlap between Agni and the gut microbiome provides an integrative perspective for understanding metabolic regulation and the pathogenesis of chronic diseases.

Bridging Ayurvedic principles with modern microbiome science may facilitate the development of more holistic, preventive, and personalized healthcare strategies. Future interdisciplinary studies on the Agni–gut microbiome relationship are essential to generate

scientific evidence and further strengthen the integration of Ayurveda with contemporary biomedical research.

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