

## “Ayurveda Meets Microbiome Science: Exploring the *Vipaka*–Gut–Brain Continuum”

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**Abstract:** The gut–brain axis, gut microbiota, is increasingly recognized as a key modulator of digestive, metabolic, and cognitive health. The concept of *Vipaka*, the final stage of digestion that determines the ultimate quality of the nutrients ingested, influences *Dosha* equilibrium and shapes mental states (*Manas*). Ayurveda offers an analogous perspective. According to recent studies, microbial fermentation of dietary substrates produces bioactive metabolites, particularly short-chain fatty acids (SCFAs) such as butyrate, acetate, and propionate, which influence immune signaling, intestinal integrity, neurotransmitter synthesis, and stress response pathways. The post-digestive effects of food on the gut, tissues, and psyche are governed by *Vipaka*, according to Ayurveda.

An imbalance in *Vipaka*, particularly the preponderance of *Madhura*, *Amla*, or *Katu Vipaka*, leads to changes in the microbial makeup of the gut, which in turn promotes *Ama* production, gut inflammation, and disruptions in *Manovaha Srotas*, all of which have an impact on mood, emotional resilience, and

cognition. Conversely, diets promoting *madhura vipaka* and *sattvika* qualities, as advocated in Ayurveda, support a favourable microbiome and mental well-being. According to recent research, dysbiosis is also linked to altered vagal-enteric transmission, anxiety, depression, and cognitive decline. A healthy microbiome and mental well-being can be promoted by harmonizing *Vipaka* through optimal *Ahara*, *Agni*-balancing techniques, prebiotic-probiotic meals, and *Ayurvedic* treatments like *Takra*, *Triphala*, *Basti*, and *Medhya Rasayana*.

**Keywords:** Gut microbiome, *Vipaka*, Ayurveda, Mental health, Integrative medicine

### Introduction:

The gut microbiome is crucial for human physiology, affecting both health and illness. It consists of a varied community of microorganisms, which includes bacteria, viruses, fungi, and unicellular entities, with bacteria being the most prevalent.<sup>[1]</sup> The gut microbiota functions as an independent metabolic organ that exhibits significant

adaptability, fostering a symbiotic connection with the intestinal mucosa and aiding in metabolism, immunity, and the protection of the gut barrier.<sup>[2-3]</sup> It obtains nutrients from food elements and discarded epithelial cells. Elements like an inadequate diet, lifestyle discrepancies, and mental stress can disturb this balance, resulting in dysbiosis. Ayurveda emphasizes the significance of *Mahasrotasa* (gastrointestinal tract) in preserving health. The Ayurvedic pharmacokinetic idea of *Vipaka*—the unalterable post-digestive change of food and drugs—closely resembles microbial biotransformation.<sup>[4]</sup> In the colon, undigested food materials are subjected to microbial fermentation, resulting in the production of B-complex vitamins, modulation of bioactive compounds, alteration of bile acids, and the conversion of prodrugs.<sup>[5]</sup> Variations in individual microbial metabolism, especially concerning polyphenols, could affect therapeutic results.<sup>[6]</sup> Consequently, the functions of gut microbiota exhibit conceptual alignment with Ayurvedic principles regarding pharmacodynamics and pharmacokinetics.<sup>[7]</sup>

### Aim and Objective:

To evaluate the integrative relationship between the Ayurvedic concept of *Vipaka* and the modern gut microbiome–gut–brain axis, their combined influence on digestive function, microbial balance, and mental health.

1. To correlate the Ayurvedic principle of *Vipaka*
2. To evaluate the role of *Vipaka* imbalance
3. To assess the relevance of Ayurveda dietary and therapeutic interventions

### Material and Method:

It is a conceptual study (Literature study) –

Classical Ayurveda texts:

1. Charaka Samhita, Sushruta Samhita and Ashtanga Hrdaya were critically reviewed. Relevant commentaries were also reviewed for classical interpretations.
2. Other literatures from Indexed journals, AYUSH Research portals, UGC, Pubmed, SCOPUS, Secondary databases, etc. were reviewed.

### Observation and Result:

The conceptual parallels between *Vipaka* and contemporary descriptions of microbial fermentation that occurs after digestion.

Balanced *Vipaka* relates to ideal digestion, nourishment of *Dhatus*, and the stability of mental functions (*Manas*).

- Changes in *Vipaka* is associated with *Ama* formation, intestinal inflammation, and disruptions in *Manovaha Srotas*.
- Recent study shows that gut dysbiosis results in altered SCFAs production, compromised gut barrier function, immune system dysregulation, and modifications in neurotransmitter pathways.
- Ayurvedic techniques focusing on *Madhura Vipaka*, *Sattvika Ahara*, *Agni dipana*, and *Rasayana* therapy exhibit functional similarities to microbiome-modulating approaches like prebiotics and probiotics
- A combined *Vipaka–Gut–Brain* model provides an all-encompassing structure for preventive, individualized, and holistic mental health care.

### Discussion:

Ayurveda, via the idea of *Vipaka*, provides a similar explanatory structure that highlights

the enduring systemic and psychological impacts of consumed food and medications.

There are basically 4 phases:

1. Digestion and Microbiome Co-relation
2. *Vipaka* and Microbial Dysbiosis Metabolites
3. *Ama* formation and Inflammation (Endotoxins by Neurotransmitters)
4. Gut Brain continuum

*Prana Vayu* resides in *Hrdya* and *Mahastratasa*, and when vitiated, leads to disorders. *Sadhaka Pitta* and *Udana Vayu*, when vitiated leads to disruption of the Hypo-Pituitary Adrenaline Axis (HPA Axis), leading to endocrinal disorders. *Dosha Dhatu Dushti* disrupts Cytokines and causes inflammatory changes; *Vipaka* shows equivalence to Microbial Metabolites.

### Fundamentals of *Vipaka*

**Table 1: *Avasthapaka* and Microbiome co-relation:**

<i>Avasthapaka</i>	Site	Ayurveda Concept	Microbiome Parallel	Physiological Effect
<i>Madhura</i>	Mouth → Stomach	<i>Kapha</i> dominance	Carbohydrate breakdown, Butyrate	Anabolic, mucosal integrity, Nourishment
<i>Amla</i>	Duodenum	<i>Pitta</i> dominance	Protein digestion, bile action	Metabolic stimulation, Digestion
<i>Katu</i>	Colon	<i>Vata</i> dominance	Protein fermentation, Indole	Catabolic, excretion

### *Vipaka* and the Gut-Brain axis:

In Ashtanga *Hrdya, Sutrasthan*, it is stated that Digestion influences the heart and mind. [11] According to a review on the gut-brain axis, about 90 % of the body's serotonin is synthesized in the gut, primarily by enterochromaffin (EC) cells. [12] This 90 %

In Ayurveda, the *Ausadha Dravya* (medication) is based on the *Rasapanchaka*. [8] *Rasapanchaka* consists of *Rasa* (taste perception), *Vipaka* (after-digestion effect), *Guna* (characteristic), *Veerya* (strength), and *Prabhava* (special effect). [9] These elements constitute a fundamental component of *Ayurveda* pharmacology and pharmacokinetics. [10] Any one of these five attributions, taken separately, contributes to determining the outcome of *Dravya* without disrupting the shared penta-equilibrium. The essentials of *Vipaka* are closely related to the process following the assimilation stage of digestion in humans.

Ayurveda states the physiology (i.e., chemical and mechanical) of digestion as "*Avasthapaka*". There are basically three in number, viz *Madhura Avasthapaka*, *Amla Avasthapaka*, and *Katu Avasthapaka*.

figure refers to peripheral serotonin (i.e., outside the central nervous system). [13] Reductions in butyrate-producing gut bacteria and the consequent decrease in butyrate are associated with cognitive loss, despair, and anxiety in aging mice, according to a new study published in 2024. Butyrate replenishment

enhanced brain function, decreased inflammation, and restored the integrity of the intestinal barrier.

The study indicates that the transplantation of “aged” microbiota (which has a low number of butyrate producers) into young mice caused “gut and brain abnormalities,” resulting in cognitive decline, anxiety, and depression-like behaviours; restoring butyrate counteracted these effects. [14]

Therefore, *Vipaka* → changes in systemic *dosha* → *manas* (mind) essentially represents the Ayurveda interpretation of the gut–brain continuum (relationship).

### Role of *Agni* and *Ama* in Gut Microbiome:

It is stated that, Toxins are the by-products of the undigested or improper digestion of the food. [15-16]

*Ama* or toxins are conceptually aligned with the metabolic endotoxaemia and dysbiosis.

Example- *Grahani* is the root of systemic and neuropsychological disorders, exactly matching modern gut-brain research.



**Therapeutic Alignment of *Vipaka*  
*Aahar* (Diet)**

- ***Madhura Vipaka*:** High fibre or wholesome diet like *Shali*, *Shashtika*, *Godhuma*, *Mudga*, etc
- ***Amla Vipaka*:** Fermented food like *Takra*, *Dadima*, *Aamalaki*, etc
- ***Katu Vipaka*:** Spices such as *Kulatha*, *Patola*, *Nimba*, *Karvellak*, *Maricha*, *Pippali*, etc

### Probiotics (Mentioned in Ayurveda classics) [17]

- *Takra* (Buttermilk)
- *Kanjika*
- *Dhanyamlaka*

These Ayurveda preparations serve as natural probiotics for any digestive-related issues.

### Conclusion

Recent studies on the gut-brain axis, specifically those that illustrate the post-digestive impact on the body and mind, closely align with the *Vipaka* concept. Both systems recognize digestion as a multi-step process with end products that affect physiology, emotions, and well-being, whether they are microbial metabolites or *Madhura*, *Amla*, or *Katu Vipaka*. The *Ayurvedic* principle of *Ama* emphasizes the importance of appropriate digestion and is strongly related to modern dysbiosis and inflammatory chemicals.

This results in the *Vipaka*–Gut–Brain Continuum, which shows how diet and lifestyle have a big impact on both physical and mental health.

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