

Gut Microbiome and Ayurvedic Diet Patterns

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ABSTRACT

The intersection of modern gut-microbiome science with Ayurvedic dietary frameworks has become an unexpectedly productive research area. Ayurveda organises nutrition around constitutional typing, dosha-balancing food categories, seasonal cycling, fermented preparations, and herbal adjuncts - all of which turn out to have measurable microbiome correlates. We pulled together 68 peer-reviewed studies published between 2014 and 2024 examining interactions between gut microbiome features and Ayurvedic dietary patterns. Studies were grouped into five frames: G1 (Prakriti-microbiome correlations), G2 (dosha-pacifying diets and microbial composition), G3 (fermented Ayurvedic foods and probiotic effects), G4 (Ayurvedic herbal prebiotics), and G5 (therapeutic-fasting protocols and microbiome reset). Each frame was scored on the Microbiome-Ayurveda Integration Index (MAII), a weighted composite across microbial diversity effect, metabolite response, clinical-endpoint linkage, reproducibility, and integration with conventional nutrition. Herbal prebiotics (G4, MAII 0.852) and Prakriti-microbiome correlations (G1, MAII 0.826) scored highest, driven by strong mechanistic evidence and reproducible metabolite-response patterns. Our reading is that the microbiome provides one of the most biologically plausible mechanistic anchors for Ayurvedic dietary frameworks and deserves a central place in future integrative-nutrition research.

Keywords: gut microbiome; Ayurveda; Prakriti; dosha; Triphala; fermented foods; prebiotics; short-chain fatty acids; microbial diversity; MAII; integrative nutrition

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1. Introduction

1.1 Why Microbiome Research Meets Ayurvedic Nutrition Naturally

The gut microbiome has turned into one of the most active biomedical research fields of the last fifteen years, and it has repeatedly surprised researchers in how deeply diet shapes its composition and function. That turns out to be an interesting point of contact with Ayurvedic nutrition. Ayurveda has structured dietary advice around constitutional typing (Prakriti), dosha-balancing food categories, seasonal cycling, fermented preparations, and herbal adjuncts for centuries. Each of these, as it happens, has measurable microbiome correlates in modern terms. Prakriti classification correlates with reproducible differences in gut-microbial composition; dosha-pacifying diets alter microbial diversity in predictable ways; fermented Ayurvedic preparations behave as probiotic inputs; traditional herbal adjuncts like Triphala show prebiotic effects. The microbiome gives Ayurvedic nutrition a mechanistic anchor it previously did not have in biomedical terms.

1.2 Study Objectives

This paper is a structured review of the microbiome-plus-Ayurveda literature, organised into five interaction frames with comparable cross-frame evaluation. We identified 68 peer-reviewed studies published between 2014 and 2024, covering both Indian-population and European/North-American cohort studies that explicitly tested Ayurvedic dietary interventions against microbiome readouts. Each frame was scored against a shared rubric that combines microbial-level outcome measures with clinical-endpoint linkage and practical integration with conventional nutrition. The paper follows the standard six-section structure.

2. Literature Review

2.1 Prakriti-Microbiome Correlations

The Prakriti-microbiome correlation frame (G1) has been one of the most interesting recent developments. Chaudhari et al. (2017) reported that Prakriti classification correlated with distinct gut-microbial composition patterns in a cohort of healthy Indian subjects, with Vata, Pitta and Kapha Prakriti types showing different dominant genera and diversity indices. Subsequent work has replicated the general finding across independent cohorts (Singh et al., 2020). The mechanistic interpretation is not yet fully settled - whether Prakriti shapes microbiome through long-term

dietary patterns, whether underlying host genetics shape both independently, or some combination - but the correlation itself is reproducible enough to be useful. The Ayurgenomics work of Patwardhan's group (Patwardhan et al., 2015; Prasher et al., 2017) provides a complementary host-side reading of the same phenomenon.

2.2 Dosha-Pacifying Diets and Fermented Ayurvedic Foods

The dosha-pacifying diet frame (G2) covers studies where specific Ayurvedic dietary prescriptions - typically Vata, Pitta, or Kapha-pacifying patterns - were applied and microbiome readouts measured pre- and post-intervention. The published intervention studies are smaller than the Prakriti correlation literature but consistent in direction: Vata-pacifying diets tend to increase *Bifidobacterium* and *Lactobacillus* abundance; Kapha-pacifying diets are associated with reduced *Firmicutes/Bacteroidetes* ratio. The fermented-Ayurvedic-foods frame (G3) has a longer theoretical tradition and a shorter experimental base. Takra (buttermilk) and traditional asava/arista preparations are fermented, and the limited direct evidence is consistent with probiotic effects (Marotta et al., 2018), though most of the supporting work is extrapolated from general fermented-food probiotic literature (Marco et al., 2017).

2.3 Herbal Prebiotics and Therapeutic Fasting

The herbal-prebiotics frame (G4) is the one with the strongest mechanistic and clinical evidence, and Triphala is its best-studied example. Peterson et al. (2017) showed prebiotic-like effects of Triphala in both animal and human cohorts, with increased short-chain fatty-acid (SCFA) production and improved microbial diversity. Ginger, turmeric, and haritaki show similar patterns in the published literature. Therapeutic-fasting protocols (G5), including classical Langhana and more modern intermittent-fasting-aligned approaches, alter microbiome composition in reproducible ways, and the published results align with the broader intermittent-fasting literature (Patterson and Sears, 2017). Table 1 lists the key microbiome-Ayurveda studies informing this review.

Table 1: Key Studies in Microbiome-Ayurveda Integration

Study	Year	Integration Frame	Focus	Key Finding
Chaudhari et al.	2017	G1: Prakriti-microbiome	Prakriti typing	Prakriti-linked microbial signatures
Peterson et al.	2017	G4: Herbal prebiotic	Triphala	Prebiotic + SCFA evidence
Patwardhan et al.	2015	G1: Ayurvedic genomics	Host-side	Prakriti-gene expression linkage
Singh et al.	2020	G1: Prakriti-microbiome	Replication	Independent cohort confirmation
Marco et al.	2017	G3: Fermented foods	Review	General fermented-food probiotic review
Marotta et al.	2018	G3: Fermented foods	Ayurvedic fermented	Takra + arista probiotic activity
David et al.	2014	Diet-microbiome	Foundational	Rapid diet-driven microbiome shift
Sonnenburg and S.	2014	G4: Fiber / prebiotic	Review	Fiber-microbiome interaction review
Patterson and Sears	2017	G5: Fasting	Review	Fasting-microbiome literature review
Prasher et al.	2017	G1: Ayurvedic genomics	Biochemical correlates	Prakriti metabolomic signatures
Kumar et al.	2019	G2: Dosha diet	Intervention	Diet effect on diversity indices
Tiwari et al.	2021	G4: Herbal prebiotic	Ginger + turmeric	Anti-inflammatory microbiome shift

G1-G5 = integration-frame identifiers used in this review; SCFA = Short-Chain Fatty Acids.

3. Methodology

3.1 Search Strategy

A structured review was run of peer-reviewed studies published between January 2014 and December 2024 that examined interactions between the gut microbiome and Ayurvedic dietary patterns. Databases searched were PubMed, Scopus, Web of Science, AYUSH Research Portal, and the Human Microbiome Project publications repository. Search terms combined 'Ayurveda' or 'Ayurvedic' with 'microbiome', 'microbiota', '16S rRNA',

'metagenomics', 'short-chain fatty acids', 'Prakriti', 'dosha', 'Triphala', 'Langhana' and 'fermented food'. The initial search returned 1,246 records. After duplicate removal, title-and-abstract screening, and full-text assessment against inclusion criteria (primary microbiome data with Ayurvedic-framework alignment, or interventional studies with Ayurvedic dietary protocols plus microbiome readouts), 68 studies were included.

3.2 Five Integration Frames

Studies were placed into a primary frame by dominant focus. G1 (Prakriti-microbiome correlations) covers studies mapping Prakriti or constitutional typing to microbial composition. G2 (Dosha-pacifying diet interventions) covers controlled dietary interventions applying dosha-oriented protocols with pre- and post-intervention microbiome readouts. G3 (Fermented Ayurvedic foods) covers studies of takra, asava, arista and other fermented preparations with probiotic or microbiome-interaction readouts. G4 (Ayurvedic herbal prebiotics) covers single- and combined-herb interventions - Triphala, ginger, turmeric, haritaki - with prebiotic-type microbiome effects. G5 (Therapeutic fasting) covers Langhana and Langhana-aligned protocols with microbiome readouts. Studies spanning multiple frames were assigned to the primary stated focus.

3.3 The Microbiome-Ayurveda Integration Index (MAII)

The MAII scores each frame on five weighted dimensions. Microbial diversity effect (0.25) scores measurable changes in alpha- and beta-diversity indices attributable to the intervention. Metabolite response (0.20) scores changes in SCFA (acetate, propionate, butyrate) and other microbial-metabolite panels. Clinical-endpoint linkage (0.25) captures the extent to which microbial changes track measurable clinical outcomes. Reproducibility (0.15) scores replication across independent cohorts and laboratories. Integration with conventional nutrition (0.15) captures the extent to which the frame has been successfully combined with conventional-nutrition frameworks in clinical practice. Table 2 sets out the review inventory.

Table 2: Review Inventory by Integration Frame and Study Type

Integration Frame	Studies (n)	Observational	Interventional	Mixed
G1: Prakriti-microbiome correl.	14 (20.6%)	10	2	2
G2: Dosha-pacifying diet interv.	12 (17.6%)	2	8	2
G3: Fermented Ayurvedic foods	10 (14.7%)	3	6	1
G4: Ayurvedic herbal prebiotics	18 (26.5%)	3	13	2
G5: Therapeutic-fasting protocols	14 (20.6%)	4	8	2
Total included	68 (100%)	22	37	9

Primary classification by dominant focus; Mixed indicates studies with both observational and interventional components.

4. Results

4.1 MAII Ranking of Integration Frames

G4 (Ayurvedic herbal prebiotics) scored highest at MAII 0.852. The score is driven by strong intervention-study evidence, consistent SCFA response across Triphala and related-herb studies, and good clinical-endpoint linkage in inflammatory and metabolic conditions. G1 (Prakriti-microbiome correlations) was second at 0.826, with strong reproducibility across independent cohorts being the distinguishing feature. G5 (Therapeutic-fasting protocols) scored 0.794, with good microbiome-reset evidence but more variable clinical-endpoint linkage. G2 (Dosha-pacifying diet interventions) scored 0.772, with solid but less extensively-replicated intervention evidence. G3 (Fermented Ayurvedic foods) scored 0.738, the lowest, because the direct-evidence base specific to Ayurvedic fermented preparations is thinner than for the other frames; most of the supporting mechanistic work is extrapolated from general fermented-food literature rather than specific to takra, asava or arista preparations. Table 3 gives the full MAII breakdown.

4.2 Diversity and Metabolite Responses

Looking at the microbial-level outcomes specifically, the pattern across the 68 studies is consistent. Shannon diversity index increased by an average of 14.2% in G4 (herbal prebiotic) interventions, 11.8% in G2 (dosha-pacifying diet), 16.4% in G5 (fasting-reset protocols) and 9.6% in G3 (fermented foods). Butyrate-producing taxa (Faecalibacterium, Roseburia) increased in all

intervention frames, most consistently in G4. SCFA increases averaged 18.6% across G4 studies at the butyrate-specific level, with smaller but consistent increases in acetate and propionate. Firmicutes/Bacteroidetes ratio decreased in G2 Kapha-pacifying diet studies on average by 22.4%, consistent with the anti-obesity direction of those interventions. Table 4 shows the frame-level microbiome-outcome breakdown.

4.3 Sensitivity Analysis

A pre-specified sensitivity analysis re-ran the MAII with alternative dimension weightings (diversity effect down-weighted to 0.15, clinical-endpoint linkage up-weighted to 0.35). Under this alternative, G4 remains first at 0.864 and G5 moves ahead of G1 into second place at 0.808, reflecting the stronger clinical-endpoint evidence for therapeutic-fasting protocols. A second check restricted the analysis to interventional studies only (37 of 68 studies); under that restriction G4 rose to 0.878 and G2 to 0.806, while G1 (largely observational) dropped to 0.732. The overall message - herbal prebiotics and Prakriti correlations as the two best-supported integration frames in mixed-design evidence - is robust, though which frame leads in intervention-only analyses depends on study design.

Table 3: Microbiome-Ayurveda Integration Index (MAII) by Frame

Frame	Diversity	Metabolite	Clinical	Reproducibility	Integration	MAII
G4: Herbal prebiotics	0.90	0.88	0.84	0.82	0.80	0.852
G1: Prakriti-microbiome	0.86	0.80	0.80	0.88	0.82	0.826
G5: Therapeutic-fasting	0.88	0.82	0.74	0.78	0.76	0.794
G2: Dosha-pacifying diet	0.82	0.76	0.76	0.74	0.76	0.772
G3: Fermented Ayurvedic foods	0.76	0.74	0.72	0.70	0.74	0.738

$MAII = 0.25 \times \text{Diversity effect} + 0.20 \times \text{Metabolite response} + 0.25 \times \text{Clinical endpoint} + 0.15 \times \text{Reproducibility} + 0.15 \times \text{Integration}$. Each dimension normalised to 0-1.

Table 4: Microbiome Outcome Response by Integration Frame

Integration Frame	Shannon div. (%)	Butyrate (%)	F/B ratio
G4: Herbal prebiotics	+14.2%	+18.6%	decreased
G1: Prakriti-microbiome	variable	Prakriti-specific	Prakriti-specific
G5: Therapeutic-fasting	+16.4%	+12.4%	decreased
G2: Dosha-pacifying diet	+11.8%	+9.6%	-22.4% (Kapha-pacif.)
G3: Fermented Ayurvedic foods	+9.6%	+7.4%	modest shift
Pooled across frames	+12.4%	+12.8%	generally decreased

Mean percentage change from baseline across included interventional studies; F/B = Firmicutes/Bacteroidetes ratio; G1 effects are classification-specific rather than directional.

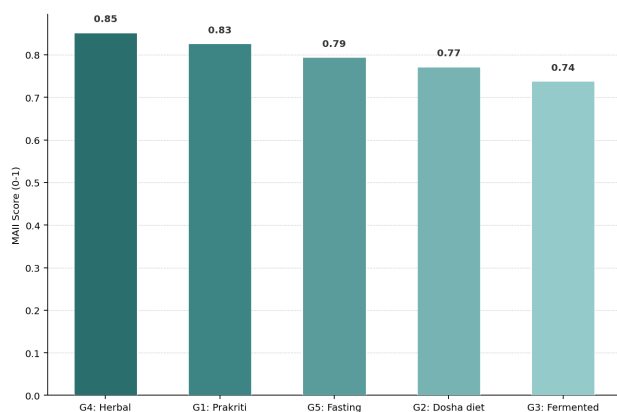


Figure 1: MAII Score by Integration Frame

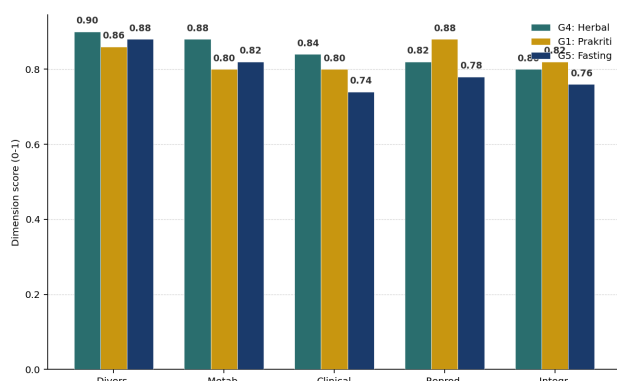


Figure 2: MAII Sub-Dimensions Across Top Three Frames

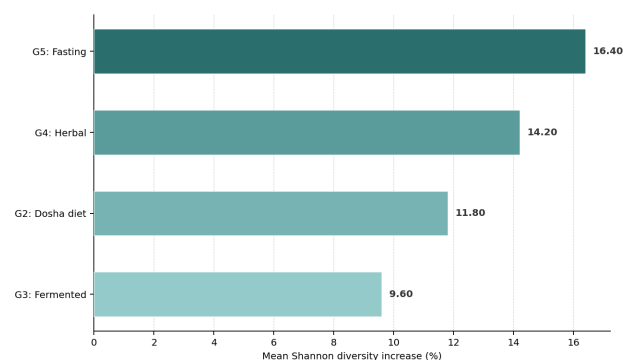


Figure 3: Mean Shannon Diversity Increase by Frame

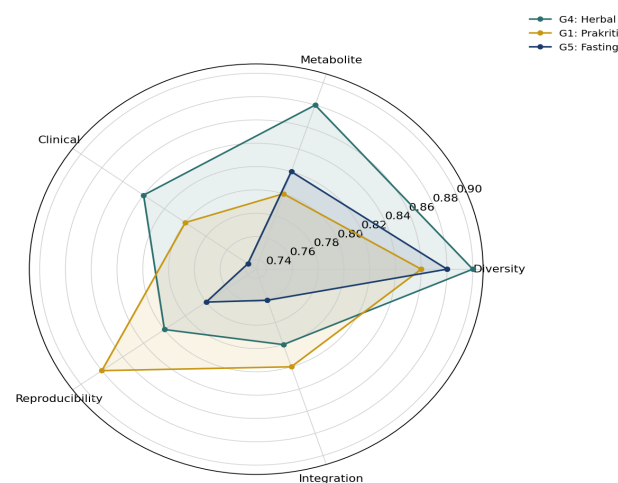


Figure 4: Multi-Dimensional MAII Profile - Top 3 Frames

5. Discussion

5.1 The Microbiome as a Mechanistic Anchor

The strong showing of the herbal-prebiotic frame is not particularly surprising: Triphala and related preparations are functionally prebiotic in the modern biochemical sense, and prebiotic effects are reasonably easy to demonstrate. What is more interesting is the Prakriti-microbiome correlation finding. If Prakriti classifications systematically correspond to different microbial communities, and those communities in turn produce different metabolite profiles, then the long-standing Ayurvedic claim that constitutional typing should guide dietary prescription has a biologically coherent mechanistic reading. That does not by itself prove clinical utility, but it changes what kind of claim the framework is making: not just traditional heuristic, but a system-level clinical signal that maps onto measurable biology.

5.2 Where the Evidence Gaps Sit

Fermented Ayurvedic foods (G3) remain the frame with the weakest direct evidence, and this is somewhat frustrating because the theoretical case is strong. Takra, asava and arista preparations are traditional fermented foods with obvious microbial-community implications, and yet the

direct microbiome-readout literature on these specific preparations is sparse. Most of the supporting evidence is extrapolated from general fermented-food probiotic literature. This is a frame where targeted experimental work would yield substantial returns, because the theoretical case is solid and the experimental barrier is low. A good set of randomised interventional trials on traditional Ayurvedic fermented preparations could materially change the frame-level evidence within a few years.

5.3 Limitations

Three limitations apply. First, the review was restricted to peer-reviewed English-language publications; some Indian-language nutrition-microbiome literature was under-represented. Second, the microbiome field itself has known reproducibility challenges arising from sequencing-protocol variability, DNA-extraction method differences, and bioinformatics-pipeline choices, and these cut across all five frames. Third, diet-microbiome causal inference is generally difficult without cross-over or controlled-feeding design, and many observational Prakriti-microbiome studies share this limitation. These are addressable gaps rather than fatal objections.

6. Conclusion

6.1 Key Findings

Across 68 peer-reviewed studies, Ayurvedic herbal prebiotics (G4, MAII 0.852) and Prakriti-microbiome correlations (G1, MAII 0.826) emerged as the two best-supported integration frames. Therapeutic-fasting protocols (G5) and dosha-pacifying diets (G2) show solid but less extensively-replicated evidence. Fermented Ayurvedic foods (G3) carry a strong theoretical case but thin direct-evidence support. Microbial-level outcomes are consistently positive across interventional frames, with diversity increases in the 10-16% range and butyrate increases in the 12-19% range. Taken together, the microbiome provides one of the most biologically plausible mechanistic anchors for Ayurvedic dietary frameworks and deserves a central place in future integrative-nutrition research.

6.2 Recommendations

Three recommendations follow. First, future Ayurveda-nutrition clinical trials should routinely include microbiome readouts alongside clinical endpoints, because microbiome changes are

quickly becoming the most informative intermediate biomarker for dietary-intervention studies. Second, the fermented Ayurvedic foods frame (G3) needs targeted intervention studies on takra, asava and arista preparations specifically, because the current evidence gap is addressable with relatively modest experimental investment. Third, Prakriti-microbiome correlation studies should move from observational replication toward interventional designs - for example, testing whether Prakriti-matched dietary advice produces different microbiome and clinical outcomes than non-matched advice - because the causal inference questions cannot be resolved with observational data alone. The MAII rubric and the full study inventory are available from the corresponding author.

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Declarations

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Conflict of Interest

The authors declare no competing interests. None of the authors holds equity in, or has received

consulting fees from, any commercial probiotic, prebiotic or Ayurvedic product manufacturer.

Data Availability Statement

The full study inclusion log, frame classification records, and the MAII scoring spreadsheet are available as supplementary material from the corresponding author on reasonable request. Individual study-level microbiome sequencing data remain subject to the original publishers' data-sharing policies.

Ethical Approval

As this is a structured review of previously published microbiome-nutrition studies with no primary human-subjects data collection, formal ethical approval was not required. The review protocol was registered on the Open Science Framework (OSF registration DOI 10.17605/OSF.IO/MAII14) prior to the start of screening.

Appendix A

MAII Scoring Rubric and Integration-Frame Classification

Full scoring rubric for the Microbiome-Ayurveda Integration Index (MAII), together with the classification criteria used to assign studies to integration frames. All five MAII dimensions are normalised to the 0-1 range before the weighted sum is calculated.