

Ethnobotanical Gut Healing Therapies of Indian Tribes: Microbiome Modulation and Ayurvedic Perspectives

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Abstract

The human microbiota is crucial for digestion, immunity, metabolism, and wellness. Dysbiosis, an imbalance in gut bacteria, is linked to conditions such as irritable bowel syndrome, inflammatory bowel disease, peptic ulcers, and metabolic disorders. Both conventional and traditional medicines use herbs to treat digestive issues and improve gastrointestinal health. Indian cultures have a rich tradition of using medicinal herbs for gastrointestinal ailments, such as digestive disorders, diarrhea, constipation, gastritis, and indigestion, often prepared as decoctions, powders, fermented mixtures, or kadha. These plants alter the microbiota composition, eliminate harmful strains, and boost short-chain fatty acid levels. Their chemical components, including polyphenols, alkaloids, flavonoids, tannins, and terpenoids, have anti-inflammatory, antimicrobial, and antioxidant properties that protect the gut lining. Ayurvedic remedies align with the vata, pitta, and kapha, maintaining the tri doshas balance. This review highlights the Indian tribal use of herbs for gastrointestinal health and how modern science and Ayurveda can enhance the understanding of their benefits. Ancient wisdom and microbiome research together offer improved, cost-effective, and culturally relevant solutions for gastrointestinal issues.

Keywords: - Ethnobotanical, Microbiome, Gut health, Plant extract, Ayurveda

1. Introduction

The human gastrointestinal system contains microorganisms that are essential for maintaining body homeostasis. Dysbiosis, a microbial imbalance, is linked to digestive and systemic health conditions, including inflammatory bowel disease, obesity, diabetes, and neurological problems.(Ammar et al. 2023). Scientific studies show that food- and plant-based therapies affect digestive tract function, highlighting natural interventions' role in maintaining a balanced gut environment.(Baslam et al. 2023). India is recognized as one of the most biodiverse nations globally, possessing a rich history of ethnobotanical knowledge, particularly among tribal communities.(Baslam et al., 2024). Tribes use medicinal herbs for therapy. This is particularly true in isolated areas that lack access to contemporary medical care.(Beri 2018). Nearly 80% of the global population relies on traditional herbal medicine, especially Indian tribal practices, which have significant healing properties. These traditional ethnomedicinal practices employ plant-based therapies to treat various gastrointestinal problems, including dysentery, diarrhea, and digestive issues.(Boling et al. 2020).

Tribal ceremonies and dietary practices significantly affect the gut microbiome. Studies of indigenous cultures in Arunachal Pradesh show that traditional diets rich in fiber, fermented foods, and plant-based components provide varied bacterial profiles with therapeutic insights and antimicrobial health benefits (Brochot and Azalbert 2019). Findings suggest that tribal societies adopt microbiome-promoting strategies for gut health and use therapeutic herbs. Ayurveda and traditional Indian systems offer a framework aligning with contemporary microbiome research. (Clark et al. 2017). The concepts of "Ama" (toxins) and "Agni" (digestive fire) are associated with microbial imbalance and gut metabolism, respectively. Research has demonstrated that herbal formulations,

including bioactive compounds such as flavonoids, alkaloids, and polyphenols, can enhance intestinal barrier function, reduce inflammation, and alter the gut microbiota (Cornadó and Raaijmakers 2025).

Despite growing interest, ethnobotanical interventions for gastrointestinal health lack robust scientific validation. Recent therapies may integrate Ayurvedic principles, modern microbiome research, and indigenous knowledge. This review elucidates Indian tribal ethnobotany in gut healing by examining microbiome functionality and connections with Ayurvedic principles.

2. Data mining

To gather data from the scientific literature, ethnobotanical records, Ayurvedic references, and microbiome studies, an effective data-mining approach was used. This study aimed to identify medicinal plants used by Indian tribes for gastrointestinal ailments and correlate them with gut microbiota development through pharmacological evidence. Scientific journals such as PubMed, Google Scholar, ScienceDirect, Scopus, Web of Science, and SpringerLink facilitated the review. Ethnobotanical data on Indian tribal medicine were obtained from field surveys, reports, journals, and dissertations. The efficacy of Ayurvedic plants on gastrointestinal functions was shown through contemporary Ayurvedic pharmacopoeias and classical literature, including Charak Samhita, Sushruta Samhita, and Bhavaprakasha Nighantu.

Keywords used for article searches included ethnobotany, tribal medicine, gastrointestinal disorders, gut healing plants, diarrhea, dysentery, constipation, indigestion, Ayurvedic herbs, Agni, Ama, gut microbiome, probiotics, prebiotics, microbiota modulation, anti-inflammatory medicinal plants, and herbal formulations for gut health. These keywords were used to identify many relevant publications. The literature review focused on phytochemicals with antimicrobial, anti-inflammatory, or prebiotic properties, medicinal plants used by Indian tribes for gastrointestinal issues, evidence of plant effects on the microbiome, and studies linking Ayurveda to digestive health. Articles not identifying plants, unrelated to Indian tribes, or on gut health were excluded. Botanical nomenclature, family classification, plant part used, preparation technique, tribal locality, gastrointestinal ailment treated, and pharmaceutical effects were sourced from references. Plants were categorized as carminative, anti-inflammatory, laxative, antidiarrheal, or anti-ulcer herbs. Emphasis was placed on plants with polyphenols, flavonoids, tannins, and dietary fibers for their microbiota influence. The final edition linked tribal gut healing knowledge with Ayurvedic concepts such as Agni, Ama, and Dosha imbalance. These plants may affect gut microbial diversity, suppress harmful bacteria, and enhance beneficial bacteria such as Lactobacillus and Bifidobacterium. This comprehensive data analysis establishes a basis for evaluating the potential microbiome impact of ethnobotanical treatments.

3. Critical analysis

3.1 Concept of Gut Health: A Brief Overview

Meaning of Gut Health

Gut health is the optimal functioning of the digestive system, particularly the stomach and intestine. A healthy gut is essential for digestion, nutrient absorption, combating infections, and maintaining a balanced microbiome. Gut health relies on an appropriate diet, regular bowel movements, and a healthy intestinal lining. (Cossiga et al. 2021). Microbiota, robust immunological response within the stomach (intestine)

Common Gut Disorders in Modern Lifestyles

Contemporary lifestyle factors like junk food, stress, irregular sleep, sedentary behavior, alcohol, smoking, and erratic eating have increased the risk of digestive disorders. (Das et al. 2026). The prevalent gastrointestinal problems observed are illustrated in Table 1.

Table 1. Major gastrointestinal disorders are associated with modern lifestyle factors, including their symptoms and common etiological causes.

Gut Disorders	Meaning/Description	Common Symptoms	Major Causes
Constipation	Difficulty in passing the bowl	Hard stool, Stomach pain	Low fibre diet, lack of exercise
Diarrhoea	Frequent loose or watery stools	Dehydration, weakness	Contaminated food, gut imbalance

Gut dysbiosis	Imbalance of gut microbiota (good vs bad bacteria)	Gas, weak immune system	Junk food, Stress, low fibre diet
Gastritis	Inflammation of the stomach Lining	Nausea, vomiting	Alcohol, spicy food
IBS (irritable bowel syndrome)	Disorder affecting digestion	Bloating, Constipation, Abdominal cramps	Poor sleep habits

Dysbiosis and Diseases Link

Dysbiosis is an imbalance in gut microbiota, disrupting the balance between beneficial and harmful bacteria. In a healthy gut, microbes aid digestion, maintain immune balance, and protect against infections. (David et al. 2014). However, dysbiosis exacerbates inflammation and leads to numerous disorders.

Disease Associated with Dysbiosis

1. Gastrointestinal Disorders: IBS, IBD, diarrhoea, Constipation, Gastritis, Ulcers
2. Metabolic Disorders: Obesity, Type 2 Diabetes, Metabolic syndrome, Fatty liver disease
3. Immune and Allergic Disorders: Asthma, Food allergies, Autoimmune Diseases
4. Cardiovascular Disorders: Atherosclerosis, Hypertension, Heart disease
5. Neurological Disorders (Gut-Brain Axis): Depression, Anxiety, Alzheimer’s disease

3.2 Gut-Brain Axis

Bidirectional communication between the gastrointestinal tract and the central neurological system (Farag et al. 2022). The stomach and brain communicate to regulate immunity, metabolism, digestion, emotions, and behavior.

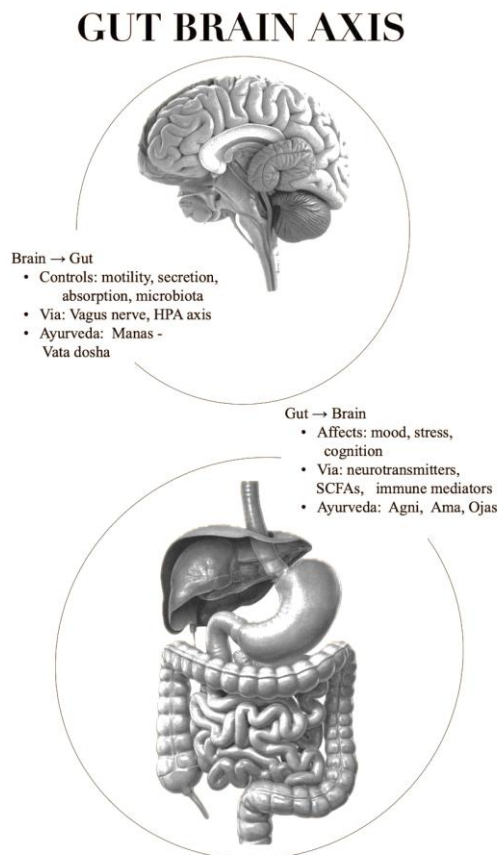


Figure 1. Bidirectional communication between the gut and brain in the gut–brain axis

Gut–Brain Axis in Ayurveda

This contemporary scientific concept closely parallels the Ayurvedic notion that digestion (Agni) directly influences mental stability (Manas) and overall well-being.(Gao et al., 2025). In both systems, the gut serves not only as a digestive organ, but also as a crucial component of general physical and mental well-being.(Garcia-ibañez et al. 2021). From a scientific perspective, the gastrointestinal tract communicates with the brain via the vagus nerve, neurotransmitters, immunological mediators, and hormonal pathways (the HPA axis). Ayurveda elucidated this functional relationship by harmonizing the Doshas, maintaining Agni's activity, and regulating the Srotas (body channels)(Hicks et al. 2018). The vagus nerve and enteric nervous system parallel the Ayurvedic concept of vata, which governs movement, nerve impulses, and intestinal motility.(Hy et al., 2025). Imbalances in Vata may result in constipation, bloating, anxiety, sleeplessness, and restlessness.(Jacky et al., 2023). This aligns with contemporary research indicating that alterations in gut motility and dysbiosis may contribute to stress-related diseases, including irritable bowel syndrome (IBS)(Kadharusman et al. 2025).

Microbial metabolites, including short-chain fatty acids (SCFAs), serotonin precursors, and GABA, influence inflammation and cerebral function.(Kwandee et al. 2023). Ayurveda explained these outcomes through Agni-driven digestion and metabolism, where proper digestion promotes nourishment (Dhatu production) and mental clarity. When digestion is impaired, toxic metabolic waste (Ama) accumulates. This parallels contemporary theories on the translocation of gut-derived endotoxins, oxidative stress, and inflammatory mediators into the bloodstream due to increased intestinal permeability (leaky gut). This inflammation can disrupt the equilibrium of neurotransmitters, potentially resulting in depression, weariness, and cognitive impairment.(Li et al., 2022).

This paradigm associates Pitta Dosha with digestive enzymes, bile secretion, and inflammation regulation. An imbalance in Pitta can lead to hyperacidity, gastritis, ulcers, diarrhea, and irritation(Liu et al., 2025). These are indicators of inflammatory gastrointestinal disorders that influence mood and body response to stress. Kapha Dosha, representing stability, mucus synthesis, and tissue sustenance, parallels gut barrier protection and immunological tolerance(Liu et al. 2022). Kapha aggravation results in sluggish digestion, a sensation of heaviness, weight gain, and depression, akin to metabolic illnesses that impact the microbiome(Nakamura et al., 2025).

Contemporary research and Ayurveda agree that gut microbiota balance, immune system modulation, neurotransmitter synthesis, and digestion impact cerebral health.(Pacyga and Tabi 2025). In conclusion, the gut-brain axis represents the tangible manifestation of Agni regulation and Tridosha equilibrium. Maintaining gut equilibrium supports both mental and emotional well-being, as well as digestive health.

3.3 Ethnobotany and Tribal Medicine in India

Ethnobotany and Tribal Medicine in India involves the traditional plant use by tribes for medicinal purposes.(Park et al. 2018)India is one of the wealthiest countries in terms of biodiversity, and indigenous peoples have contributed to the preservation of ancient plant-based medicinal flora. (Pastoriza 2020).

Meaning of Ethnobotany

Ethnobotany studies human-plant interactions, focusing on indigenous use for medicine, food, rituals, shelter, and agriculture.(Pausan et al. 2022). In India, ethnobotany is intricately connected to tribal lifestyles, as these communities rely significantly on trees for their existence.

Importance of Tribal Ethnomedicine

Tribal medicine plays an important role because:

1. Available in remote areas and affordable healthcare.
2. This preserves the traditional medicinal knowledge.
3. Many modern drugs are derived from tribal medicinal plants.
4. This supports biodiversity conservation.

3.4 Plant Part Used

Table 2. Ethnobotanical medicinal plants are traditionally used for gastrointestinal disorders and their potential mechanisms in gut microbiome modulation.

Plant	Botanical Source	Major Phytochemicals	Traditional Uses	Mechanism of Microbiome Modulation
Curcuma longa (Turmeric)	Zingiberaceae	Curcuminoids	Anti-inflammatory digestive tonic	Regulates microbial diversity and suppresses inflammatory signalling
Zingiber officinale (Ginger)	Zingiberaceae	Gingerols, shogaols	Relieves indigestion and nausea	Enhances gastric motility and reduces gut inflammation
Glycyrrhiza glabra (Licorice)	Fabaceae	Glycyrrhizin	Gastritis and ulcer therapy	Modulates gut bacteria and strengthens the mucosal barrier
Tinospora cordifolia (Guduchi)	Menispermaceae	Alkaloids, polysaccharides	Immunomodulatory digestive tonic	Promotes beneficial bacteria and SCFA production
Aegle marmelos (Bael)	Rutaceae	Tannins, coumarins	Antidiarrheal herb	Restores intestinal microbiota balance
Allium sativum (Garlic)	Amaryllidaceae	Allicin	Antimicrobial digestive remedy	Inhibits pathogenic bacteria
Aloe vera	Asphodelaceae	Antraquinones, polysaccharides	Laxative and mucosal healer	Acts as a prebiotic substrate
Phyllanthus emblica (Amla)	Phyllanthaceae	Polyphenols, vitamin C	Digestive rejuvenator	Enhances beneficial gut bacteria
Azadirachta indica (Neem)	Meliaceae	Limonoids	Anti-infective herb	Suppresses pathogenic microbes
Foeniculum vulgare (Fennel)	Apiaceae	Essential oils	Carminative digestive aid	Reduces gas-producing bacteria

4. Discussion

The interaction between medicinal plants and gut microbiota represents a promising frontier in integrative medicine.(Puhlmann and Vos 2022). Phytochemicals in ethnobotanical remedies can act as substrates for microbial metabolism, producing bioactive metabolites that influence the host physiology. Polyphenols from plants like Amla and Turmeric undergo microbial transformation in the colon, generating metabolites with enhanced antioxidant and anti-inflammatory activity.(Quiroz-Guzmán et al. 2023). Similarly, polysaccharides found in Aloe vera and Tinospora cordifolia function as prebiotic fibers that stimulate beneficial bacterial growth(Rahaman et al. 2026). Traditional herbal preparations often involve combinations of plants, fermentation processes, or decoctions that may further enhance bioavailability and microbial interactions.(Santhiravel et al., 2022). These complex formulations resemble modern synbiotic therapies, which combine probiotics and prebiotics to restore microbial balance. Moreover, Ayurvedic interpretations of digestive health emphasize individualized treatment based on dosha imbalance, dietary habits, and lifestyle factors.(Silva et al., 2022). Such personalized approaches align with the emerging concepts of precision microbiome therapy, where interventions are tailored according to microbial composition.(Suphoronski et al. 2019). Further research is needed to validate the therapeutic efficacy of ethnobotanical remedies and clarify their microbiome modulation.

5. Conclusion

The ethnobotanical gut-healing therapies of Indian tribal communities combine traditional knowledge with modern science. These plant-based remedies have long managed digestive issues like diarrhea, gastritis, dysentery, and intestinal inflammation.(Tako 2020)Pharmacological studies increasingly support the therapeutic relevance of these plants, showing their bioactive compounds possess antimicrobial, anti-inflammatory, antioxidant, and mucosal-protective properties.(Tang et al. 2023). Many phytochemicals influence gut microbial diversity by promoting beneficial bacteria and suppressing pathogens. Ayurvedic principles like Agni regulation and Tridosha balance parallel contemporary microbiome research.(Vamanu et al. 2018). Both perspectives highlight the role of

digestive equilibrium in health. Future research combining ethnobotanical knowledge, microbiome science, and clinical pharmacology may create culturally rooted, scientifically validated therapies.(Wan et al. 2022). Such approaches may provide sustainable and affordable solutions for managing the gastrointestinal health of diverse populations.

6. References

1. Ammar RM, Pferschy-Wenzig EM, Abbee P Van Den, et al (2023). Phytomedicine: Possible role of the gut microbiome in mediating the beneficial effects of the six-herbal formulation STW 5-II on digestive health. *Phytomedicine* 119:154996. <https://doi.org/10.1016/j.phymed.2023.154996>
2. Baslam A, Aitbaba A, Hanchi AL, Tazart Z (2023) Modulation of Gut Microbiome in Ecstasy / MDMA-Induced Behavioral and Biochemical Impairment in Rats and Potential of Post-Treatment with *Anacyclus pyrethrum* L Aqueous Extract to Mitigate Adverse Effects
3. Baslam A, Kabdy H, Chait Y, et al. (2024) Gut Microbiome-Mediated Mechanisms in Alleviating Opioid Addiction with Aqueous Extract of *Anacyclus pyrethrum*. *Biomedicines* 12:. <https://doi.org/10.3390/biomedicines12061152>
4. Beri K (2018) Perspective : Stabilizing the Microbiome Skin-Gut-Brain Axis with Natural Plant Botanicals. <https://doi.org/10.3390/cosmetics5020037>
5. Boling L, Cuevas DA, Grasis JA, et al (2020) Dietary prophage inducers and antimicrobials : toward landscaping the human gut microbiome. *Gut Microbes* 11:721–734. <https://doi.org/10.1080/19490976.2019.1701353>
6. Brochot A, Azalbert V (2019) A Two-Week Treatment with Plant Extracts Changes Gut Microbiota, Caecum Metabolome, and Markers of Lipid Metabolism in ob/ob Mice. 1900403:1–12. <https://doi.org/10.1002/mnfr.201900403>
7. Clark AK, Haas KN, Sivamani RK (2017) Edible Plants and Their Influence on the Gut Microbiome and Acne. <https://doi.org/10.3390/ijms18051070>
8. Cornadó D, Raaijmakers JM (2025) The soil-plant-human gut microbiome axis into perspective
9. Cossiga V, Lembo V, Nigro C, et al (2021) The Combination of Berberine, Tocotrienols and Coffee Extracts Improves Metabolic Profile and Liver Steatosis by the Modulation of Gut Microbiota and Hepatic miR-122 and miR-34a Expression in Mice
10. Das M, Pundeer M, Ponnusamy R, Patra S (2026) Effect of Plant Extract Used in Ayurveda and Siddha Medicine on Asthmatics and Their Role in Maintaining Gut Microbiota Diversity – A Narrative Review. 5:30–46
11. David LA, Maurice CF, Carmody RN, et al. (2014) David, L. A., Maurice, C. F., Carmody, R. N., Gootenberg, D. B., Button, J. E., Wolfe, B. E., ... Turnbaugh, P. J. (2014). NIH Public Access. *Nature*, 505(7484), 559–563. <https://doi.org/10.1038/nature12820>.Diet. *Nature* 505:559–563. <https://doi.org/10.1038/nature12820>.Diet
12. Farag MA, Abdel ZT, Elmassry MM, Donia MS (2022) Metabolites profiling reveals gut microbiome-mediated biotransformation of green tea polyphenols in the presence of N -nitrosamine as pro-oxidant. *Food Chem* 371:131147. <https://doi.org/10.1016/j.foodchem.2021.131147>
13. Gao C, Huang Q, Yang X, et al (2025). Diet and environment drive the convergence of gut microbiome in wild-released giant pandas and forest musk deer. *iScience* 28:112837. <https://doi.org/10.1016/j.isci.2025.112837>
14. Garcia-ibañez P, Roses C, Agudelo A, et al (2021) The Influence of Red Cabbage Extract Nanoencapsulated with Brassica Plasma Membrane Vesicles on the Gut Microbiome of Obese Volunteers
15. Hicks AL, Lee KJ, Couto-Rodriguez M, et al (2018) seasonally in response to diet. *Nat Commun*. <https://doi.org/10.1038/s41467-018-04204-w>
16. Hy A, Rozenek H, Gondek E (2025) Effect of Antioxidants on the Gut Microbiome Profile and Brain Functions : A Review of Randomized Controlled Trial Studies. 1–19
17. Jacky D, Bibi C, Melvin L, et al (2023) Effects of OsomeFood Clean Label plant - based meals on the gut microbiome. *BMC Microbiol* 1–14. <https://doi.org/10.1186/s12866-023-02822-z>
18. Kadharusman MM, Syahputra RA, Kurniawan R, Hadinata E (2025) Seagrass *Enhalus acoroides* extract mitigates obesity and diabetes via GLP-1, PPAR γ , SREBP-1c modulation and gut microbiome restoration in diabetic zebrafish. 4:
19. Kwandee P, Somnuk S, Wanikorn B, et al (2023) Efficacy of Triphala extracts on the changes of obese fecal microbiome and metabolome in the human gut model. *J Tradit Complement Med* 13:207–217. <https://doi.org/10.1016/j.jtcme.2023.02.011>
20. Li X, Lin Y, Jiang Y, et al (2022) Aqueous Extract of *Phyllanthus emblica* L Alleviates Functional Dyspepsia through Regulating Gastrointestinal Hormones and Gut Microbiome In Vivo

21. Liu W, An M, Wang Q, et al (2025) Gut microbiome-induced metabolites promote the role of Silybin as an adjunctive drug in HIV-positive immunological nonresponders. *Gut Microbes Reports* 2: <https://doi.org/10.1080/29933935.2025.2569789>
22. Liu Y, Li X, Li Y, et al (2022) Gut microbiomes of cyprinid fish exhibit host-species symbiosis along gut trait and diet. *Front Microbiol* 13: <https://doi.org/10.3389/fmicb.2022.936601>
23. Nakamura M, Azuma S, Tomoda Y, et al (2025) Food Bioscience Gut microbiome modulation by *Mallotus japonicus* edible leaves in mice fed a high-sucrose, low-fibre diet. *Food Biosci* 74:107801. <https://doi.org/10.1016/j.fbio.2025.107801>
24. Pacyga K, Tabi A (2025) Medicinal Plants for a Healthy Gut Microbiome : Scientific Insights into Modern Herbal Applications. 1–73
25. Park S, Kim DS, Wu X, Yi QJ (2018) Mulberry and dandelion water extracts prevent alcohol-induced steatosis by alleviating gut microbiome dysbiosis. 882–894. <https://doi.org/10.1177/1535370218789068>
26. Pastoriza S (2020) Heliyon Plant extracts as natural modulators of gut microbiota community structure and functionality. 6: <https://doi.org/10.1016/j.heliyon.2020.e05474>
27. Pausan MR, Ardjomand-woelkart K, Röck S, et al (2022) Medicinal Plants and Their Impact on the Gut Microbiome in Mental Health : A Systematic Review. 1–76
28. Puhlmann M, Vos WM De (2022). Intrinsic dietary fibers and the gut microbiome : Rediscovering the benefits of the plant cell matrix for human health. <https://doi.org/10.3389/fimmu.2022.954845>
29. Quiroz-Guzmán E, Morreeuw ZP, Peña-Rodríguez A, et al. (2023). Flavonoid-enriched extract of *Agave lechuguilla* bagasse as a feed supplement to prevent vibriosis in Pacific white shrimp *Penaeus vannamei*. *Aquaculture* 562: <https://doi.org/10.1016/j.aquaculture.2022.738867>
30. Rahaman M, Yeshi K, Hasan M, Islam Z (2026) Novel plant-derived compounds modulate gut microbiome dysbiosis in colitis mice : A potential therapeutic avenue for inflammatory bowel disease. *Microbiol Res* 302:128343. <https://doi.org/10.1016/j.micres.2025.128343>
31. Santhiravel S, Bekhit AEA, Mendis E, et al (2022). The Impact of Plant Phytochemicals on the Gut Microbiota of Humans for a Balanced Life
32. Silva M, Cueva C, Alba C, et al (2022) Gut microbiome-modulating properties of a polyphenol-enriched dietary supplement comprised of hibiscus and lemon verbena extracts. *Monitoring of phenolic metabolites*. 91: <https://doi.org/10.1016/j.jff.2022.105016>
33. Suphoronski SA, Chideroli RT, Facimoto CT, et al. (2019) Effects of a phytogetic, alone and associated with potassium diformate, on tilapia growth, immunity, gut microbiome, and resistance against francisellosis. *Sci Rep* 9:1–14. <https://doi.org/10.1038/s41598-019-42480-8>
34. Tako E (2020) Dietary plant-origin bio-active compounds, intestinal functionality, and microbiome. *Nutrients* 12:1–4. <https://doi.org/10.3390/nu12113223>
35. Tang Q, Li J, Huang Q, et al (2023) Gut microbiome helps honeybee (*Apis mellifera*) resist the stress of toxic nectar plant (*Bidens pilosa*) exposure : Evidence for survival and immunity. 1–12. <https://doi.org/10.1111/1462-2920.16436>
36. Vamanu E, Gatea F, Sârbu I (2018). In vitro ecological response of the human gut microbiome to bioactive extracts from edible wild mushrooms. *Molecules* 23: <https://doi.org/10.3390/molecules23092128>
37. Wan F, Wang M, Zhong R, et al (2022). Supplementation with Chinese Medicinal Plant Extracts from *Lonicera hypoglauca* and *Scutellaria baicalensis* Mitigates Colonic Inflammation by Regulating Oxidative Stress and Gut Microbiota in a Colitis Mouse Model. 11:1–15. <https://doi.org/10.3389/fcimb.2021.798052>