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Ayurvedic Nutraceuticals And Their Impact On Gut Microbiota

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Abstract:
Therapeutic approaches that target our microbial fellow-travelers are becoming more and more appealing as we understand more about the different functions the gut microbiota plays in maintaining homeostasis and how a disturbed microbiome may lead to disease. The connection between the gut microbiota and health has grown more clear as research tools for the microbiome have advanced. Since ancient times, people have utilized herbal remedies because they are "easy, convenient, affordable, and efficient." However, the therapeutic uses of herbal medicines are not well known for a variety of reasons, including their complicated structure, ambiguous active ingredients, and a lack of understanding of their underlying mechanisms. The relationship between the gut microbiota and herbal remedies has been the subject of an increasing number of studies in recent years. A balanced diet based on each person's Dosha, consistent sleep schedules, stress reduction methods, and a disciplined lifestyle are all recommended by Ayurvedic practices, and they all help to maintain a healthy gut microbiota. We can improve general health outcomes and avoid a number of disorders linked to microbial imbalance by comprehending and promoting the gut microbiome using these comprehensive approaches. The effect of Ayurvedic Nutraceuticals on Gut Microbiota will be covered in this essay.

Keywords: Ayurvedic Nutraceuticals, Gut Microbiota, Agni, Gut Health, Herbal Medicines, Doshas, Lifestyle, Health Outcomes, Digestion, Metabolism, Nutrients, Dinacharya, PathyaAhara, Dietary Components,Gastrointestinal (GI) Diseases.

Introduction:
The stomach's microbiome has a distinct climate and is primarily composed of bacterial organisms. The human body is home to around 1,000 genera and nearly 40 trillion microorganisms. The bacteria in the stomach aid in the digestion and absorption of food for the production of energy, improve the functioning of the immune system, and seem to affect the brain and endocrine system. Ayurveda, an Indian holistic treatment, places a strong emphasis on preserving both bodily and mental balance. Teja (fire), akash (space), vayu (air), jala (water), and prithvi (earth) are the five elements that Ayurveda says make up the universe. It is widely acknowledged that these elements form three different doshas, which are defined as types of energy that flow through your body. Every dosha is in charge of particular physiological processes. For example, the pitta dosha controls appetite, thirst, and temperature. The Ayurvedic diet is a way of eating that is based on the principles of Ayurvedic medicine. It emphasizes balancing different types of energy inside your body, which is believed to improve your overall health. People have been following the Ayurvedic diet for thousands of years. [1,2]
Vital functions like as digestion, energy balance and metabolism, vitamin and nutrient synthesis, and immune function development and control are all influenced by the gut microbiota. Additionally, it plays a role in the synthesis of a large number of substances that enter the bloodstream and impact different body tissues and organs. Recognizing the vast differences in gut microbiota composition between individuals and between digestive tract regions is a crucial factor. Certain microbial populations, which can be immunologically more active than others, are found in particular niches throughout the intestines. Immunological equilibrium and overall health depend on a diversified and well-balanced microbiome. [3]

Concept of nutraceuticals in Ayurveda
The ancient Indian medical system known as Ayurveda made reference to the value of food, its advantages for preserving health, and its application as medicine or therapy. Numerous nutritional supplements have been mentioned by Ayurveda in a variety of circumstances, such as RituCharya (seasonal regimen) and Dinacharya (daily regimen). The roots of the contemporary nutraceutical sector can be found in Ayurveda, even though it emerged in Japan in the 1980s. Pathya, which means "wholesome food taken in the right time and quantity, that can help to recover from disease condition either alone or with other medications," is one of the Ayurvedic synonyms for treatment. A pathyaahara diet is one that benefits a person's body and mind without having any negative effects.Ayurveda provided a magnificent explanation of how to prevent, treat, and heal ailments through food and consumption practices. Vaidya Lolambara Raju says that one should eat for ojovantha (to maintain immunological fitness) as well as shariraposhana (nutrition) or dhatuposhana. The same author also claimed that "a person will not be affected with diseases needing no medicines if he

eats balanced food with rational." Similarly, "a person's disease may not be cured if they use medications without adhering to dietary protocol (pathya)."
Beyond basic nutrition, dietary components have positive effects that have sparked the growth of nutraceuticals and the functional food concept. Probiotic use in a variety of illnesses, particularly gastrointestinal (GI) disorders, is becoming more and more supported by research. The effectiveness of these probiotics is increased when they are taken with the right herbs and nutraceuticals. [4]
In a sympathetic therapeutic relationship with probiotics, ayurvedic nutraceuticals provide a wide range of herbs, cooking spices, and culinary items that may improve gut health by correcting digestive mistakes and promoting microbiome colonization. According to Ayurvedic science, the alimentary canal is the body's most vital mechanism. By relating the advantages of food to vital prana (life), Ayurveda has explained how the digestive tract is involved in other significant metabolic processes, such as the secretion of neurotransmitters, hormones, and other essential enzymes, in addition to the simple digestion and absorption of nutrients.
Food is said to boost immunity and strength, encourage growth, replenish systems, make people happier, feed their emotions, and develop their intelligence.5. The stomach is the root level of all tissue production, according to Ayurvedic physiology, which is known as "SaptaDhatuPoshana" (seven forms of tissue generation). The nutritious juice (Aahara Rasa) acquired in the early stages of digestion provides nourishment to all the tissues. Every tissue in the body is gradually formed by the intricate microscopic metabolic changes that this primordial juice goes through. Ancient literature explains how digestion supports endurance, development, sustenance, immunity, and emotional renewal. The aforementioned life traits can be impacted by any problems with the digestive system or digestion itself.

Digestion, Agni, and Their Symbiotic Association with Gut Microbiome:
In the paka (digestion, transformation) process, agni is the constant agent. A healthy metabolism is supported by the fundamental Agni hypothesis. In harmony with the physical physiological elements known as Tridosha (Vata, Pitta, and Kapha), Agni is the functional form of energy. One of Ayurveda's most potent transformational concepts is agni. High prana, or life force, longevity, vitality, sustained energy, mental clarity, and wellness are all attributed to it. The stomach is the primary location of Agni, where food is broken down and converted into a form that is bioavailable. Remarkably, Ayurveda promotes a balanced state of Agni for its impact on various systems in addition to gastrointestinal functions. For therapeutic purposes, Ayurveda takes into account the interconnected pathways between Agni and other systems. Agni is thought to be the entryway to both mental and physical wellness, much like the microbiota. According to Ayurvedic theory, Agni influences hormones, neurotransmitters, and enzymes. The Ayurvedic notion of Agni and the idea of gut microbiome appear to be closely related and can be applied to enhance gut health. In addition to supporting metabolic functions and intestinal health, physiological agni can also have an impact on psychological well-being. [5]

Review of Literature:
According to DeFelice, the term "nutraceutical," which combines the terms "pharmaceutical" and "nutrition," refers to "a food (or part of a food) that provides medical or health benefits, including the prevention and/or treatment of a disorder or disease" (Brower, 1998) [6]. Subsequently, Kalra (2003) [7] proposed that the capacity of a nutraceutical to "assist in the prevention and/or treatment of disease or disorder" set it apart from a functional food. More simply, according to Santini, Tenore, and Novellino (2017), a nutraceutical is "a food or part of a food that provides benefits to health in addition to its nutritional content" [8]. Although the different items that fall under these categories have been the focus of increased regulatory attention in recent years, the lines between dietary supplements, functional foods, and nutraceuticals have actually remained blurred (Pereira, Barros, & Ferreira, 2017; Swann, 2016). [9]. The key difference between food and drugs, according to regulatory bodies, appears to be that any product that makes claims to cure or prevent a disease or problem will, in the majority of jurisdictions, be considered a drug and be subject to the stringent regulatory procedures that come before any drug is approved. [10]

The medicinal potential of the microbiome has also been uncovered by microbiome science. Recent studies have started to pinpoint the different ways that therapies like probiotics and prebiotics could be beneficial, even though some microbiome-modulating techniques have been employed empirically for decades or even centuries (Quigley, 2019). [11]
About 90% of the species in the gut microbiota, which is primarily found in the large intestine, are members of the phyla. These various communities of microorganisms are orderly dominated by bacteria. Verrucomicrobia, Actinobacteria, Proteobacteria, Firmicutes, and Bacteroidetes (Jayasinghe et al., 2016) [12]

Prebiotic vitamins, herbal remedies, fruits, and herbs all contain components that are metabolized as xenobiotics, or substances that are not normally found in our bodies. Furthermore, secondary substances derived from the microbiota, including short-chain fatty acids and other bioactive molecules, aid in the fight against oxidative stress and support advantageous immunological and metabolic conditions in the gut environment as well as throughout the body (Vamanu, 2019). [13]

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One type of medication made from plants is herbal medicine, sometimes referred to as botanical medicine or phytomedicine. Purified herbal compounds, unrefined herbal extractions, herbal formulae, etc., are examples of herbal medications. The idea of herbal medicines can occasionally be expanded to include medicinal substances derived from animals, minerals, and fungi (World Health Organization, 2000) [14]. Traditionally, herbal remedies have been utilized for hundreds or even thousands of years in traditional medicinal systems like Ayurvedic, Chinese, and Unani medicine. About 75–80% of people worldwide are thought to get their primary medical care from herbal remedies (Kamboj, 2000) [15]. chemicals extracted from herbal medicines have been investigated as lead chemicals for drug discovery in this field.For instance, according to Boufridi and Quinn (2018), around 63% of the anticancer small molecules that have been licensed by the US Food and Drug Administration come from herbal remedies [16]. Although the effectiveness of herbal remedies in treating illnesses has been proven, it is still unknown how they work therapeutically.

The gut microbiota has been a key area of study in recent years for comprehending how diseases occur and how the human body maintains homeostasis. In order to control the human body's homeostasis and the progression of diseases, recent research has demonstrated that the gut microbiota can metabolize a variety of food and medicinal molecules and produce a number of metabolites, including polyamines, indole derivatives, and short-chain fatty acids (SCFAs) (Nicholson et al., 2012) [17].

The vast and varied collection of microorganisms that inhabit the gastrointestinal system is known as the gut microbiota, intestinal microbiota, intestinal flora, or gut flora. The intestines of humans are home to roughly 1014 microbes, which is ten times more than there are human cells overall. With about 35,000 bacterial species in human bodies overall, it includes taxa such as bacteria, eukaryotes, viruses, and even archaeon (Sekirov et al., 2010) [18]. The majority of the 300–500 types of bacteria that make up the colon's microbiota are bacteria. The human gut microbiota is mostly composed of two bacterial phyla, Firmicutes and Bacteroidetes, with 99% of the bacteria belonging to roughly 30 or 40 species, despite reports claiming there are over 50 bacterial phyla [19]. Numerous studies have documented the substantial effects of food and medications on gut microbiota, including its composition and metabolism.A significant amount of the positive or negative effects of food and medications on the human body may be attained because the gut microbiota and the human body co-produce a number of metabolites that serve as information relays between the two (Etxeberria et al., 2013). [20]

The gut microbiome has been linked to numerous illnesses thus far. These illnesses include diabetes, obesity, Alzheimer's disease, cancer, ulcerative colitis, and chronic renal disease. Numerous research conducted in recent years have demonstrated that herbal medicines, including single chemicals, single herbals, and herbal formulations, can reverse the aberrant composition of the gut microbiota in model animals and ill human cohorts (Chen et al., 2016) [21]. To demonstrate the critical function of gut microbiota in illness treatment, several research even employ germ-free animal or fecal transplantation.Chang et al., for instance, demonstrated through the use of the fecal transplantation approach that high molecular weight polysaccharides derived from Ganodermalucidum might decrease obesity in mice by altering the gut microbiota's composition (Chang et al., 2015). [22]. Kato et al. investigated the impact of the multi-herbal medication Juzentaihoto on heat shock gene expression using both germ-free and normal mice. They discovered that Juzentaihoto could alter the gut microbiota, and that the gut microbiota might alter the expression of genes related to heat shock (Kato et al., 2007). [23]

The intricate microbial community that lives in our gastrointestinal tract, known as the gut microbiota (GM), is without a doubt a major influence on human physiology. In reality, it has been demonstrated over time to be in charge of a wide range of processes, including the barrier effect, metabolic regulation, immune system modulation, and central nervous system function (Sharon et al., 2016). [24]. Among other things, GM can have an impact on our nutritional status and energy balance by producing vital vitamins, including group B vitamins, and facilitating the digestion of fibers by fermenting them into short-chain fatty acids (SCFAs), primarily acetate, propionate, and butyrate (Flint et al., 2015). [25] Among their many functions are energy storage and expenditure, appetite control, epithelial barrier strengthening, induction of interleukin (IL)10 and IL-18 production, modulation of the synthesis and release of neuroactive substances, and more. These latter are microbial metabolites that are thought to be crucial for the preservation of our metabolic, immunological, and neurological homeostasis (Koh et al., 2016) [26]. However, through the metabolism of dietary components, GM can also produce molecules that have known negative effects on human health. For example, phenolic compounds are generally linked to poor cardiovascular outcomes, branched-chain fatty acids are linked to insulin resistance, diabetes, and inflammation, and trimethylamine is converted by the host into the proatherogenictrimethylamine-N-oxide. For a review of the bioactive small molecules produced and/or contributed by GM and their effects along "the diet from the microbiome to the host axis," see Turroni et al., 2018. [27]

It should be mentioned that any vegetables can have prebiotic properties if they contain a lot of fiber. Even so, several plants in particular have demonstrated the capacity to modify the GM in a far more significant manner than would be predicted from their distinct prebiotic effect brought on by their fiber content. The roots and rhizome of the perennial herbaceous plant Cichoriumintybus have long been used in Europe to treat gastrointestinal issues (Thumann et al., 2019) [28]. C. intybus has been demonstrated to cause notable alterations in the ileal microbiota, including a decrease in E. coli counts and an increase in Lactobacillus ones, when added to the diet of farmed broilers in order to enhance their

production performance. It is evident that these impacts are linked to better growth performance. Due to its high soluble fiber content, especially inulin (Khoobani et al., 2019), dietary C. intybus powder has an undeniable prebiotic impact [29]. However, mice fed various chicory cultivars showed varying modulations of the Firmicutes/Bacteroidetes ratio and of certain bacterial genera, including Alloprevotella, Blautia, Alistipes, and Oscillibacter. The effect varied based on the chicory's genotype rather than its fiber content (Khoobani et al., 2019) [30]. The arboreal shrub Boswelliaserrata produces "frankincense," an aromatic resin. The caecal microbiota was altered by supplementing rabbit meals with B. serrata resin at varying dosages. Comparing the rabbits treated with B. serrata to the untreated control group, the results showed significant changes in the microbial populations in the cecum, including a significant decrease in the total bacterial count and specifically a decrease in Salmonella enteritidis and E. coli. These outcomes may be explained by the presence of boswellic acids, which have a potent antibacterial impact, and the high polyphenol content of B. serrata (Ismail et al., 2019). [31]

Sanivarapud, Anusha (2018) Micronutrients (nutrients and minerals), macronutrients (carbohydrates, proteins, and fats), and phytochemicals (non-supplement bioactive combinations) are all obtained from diet. According to new research, the dietary elements listed above may have a direct impact on the metabolic activity and composition of the mammalian gut microbiota, which could have an impact on both mental and physical health. The increase in the burden of chronic diseases in Western countries may be due to the slow decrease of microbial diversity and beneficial microorganisms. This perspective explores the potential use of Indian thali, an ancient diet that includes a range of colorful plant foods to supply different phytonutrients and fiber. [32]

Brunkwall, Louise (2017) The total amount of the microbial genomes in the stomach is larger than that of the human genome, and they have about 500 more characteristics that significantly enhance our capacity for coding. Key metabolic processes that depend on microbial genes include the creation of vitamins and amino acids, the synthesis of hormones and neurotransmitters, and the conversion of indigestible food fibers into short-chain fatty acids. Because it may be difficult to separate human evidence from the many animal research in the field, a review of human studies is necessary.Therefore, this review's goal is to talk about the present and possible difficulties of changing the gut microbiota in order to create treatment and preventative plans for type 2 diabetes and hyperglycemia in humans. [33]

Kurilshikov, Alexander M. (2016) In this research, we used metagenomic sequencing to examine how host genetic characteristics affect microbial species, pathways, and quality philosophy categories in 1,514 patients. Additionally, we discovered that the Bifidobacterium genus was associated with a functional LCT SNP (P = 3.45 108) and that the control of Bifidobacterium abundance is influenced by a gene–diet relationship. We found that, at the suggestive level of P 5 108, 33 loci were associated with microbial pathways and gene ontology words, while 9 loci were associated with microbial taxonomies in a genome-wide analysis. Our findings demonstrate the need of comprehending host-organism relationships in order to gain a deeper knowledge of human wellbeing. [34]

Bird, Anthony R. (2015) More and more people are realizing how nutrition and other environmental factors affect the metabolic activity and composition of the human gut microbiota, which can impact health. In order to provide a broad perspective on this vast area, this narrative study explores the important recent logical writing. How we might understand the complexity and diversity of the stomach microbial networks within and between humans has advanced remarkably as a result of atomic advances. The shape and movement of these confusing populations are greatly influenced by diet, particularly macronutrients. While some of these factors have been documented, little is known about how environmental influences, especially lifestyle factors, affect the microbiome. [35]

Tambekar, D. H. (2011) Various homegrown remedies are utilized clinically in Ayurveda to prevent or treat severe illnesses. By establishing their natural dissolvable concentrate for antibacterial potential against intestinal bacterial microorganisms, such as Escherichia coli, Staphylococcus aureus, Enterobacteraerogenes, Pseudomonas aeruginosa, Bacillus subtilis, Klebsiellapneumoniae, Salmonella typhi, Staphylococcus epidermidis, Salmonella typhimurium, and Proteus vulgaris, natural arrangements, such as Triphalachurna, Hareetakichurna, Dashm-ulachurna, Manjistadichurna, Sukhsarakchurna, Ajmodadichurna, Shivksharpachanchurna, Mahasudarshanchurna, SwadistVirechanchurna, and Pipramoolchurna, were investigated. In the current investigation, it was discovered that Triphalachurna, Hareetakichurna, and Dashmulachurna were effective against S. epidermidis, P. vulgaris, S. aureus, E. coli, P. aeruginosa, and S. typhi. In addition to being nutritional supplements, the study supports the use of these herbal formulations as medicines to prevent or control enteric bacterial infections.According to your body type, or dosha, the Ayurvedic diet lays out guidelines for what, when, and how you should consume. [36]

Since the 1960s, the scientific community has debated the concept that nutrition could affect the gut flora. In order to investigate the relationship between nutrition and the makeup and function of the gut microbiome, more recent research has concentrated on employing animal models as well as the investigation of intestinal microbiota and metagenomes. The microbiome, which in turn alters the patterns of metabolic reactions in the gut lumen, may be directly impacted by human diets. Animals fed a high-fat, high-sugar Western diet showed quick changes in the structure of the intestinal microbial community, with more members of the phylum Firmicutes and fewer members of the phylum Bacteroidetes, according to studies conducted on germ-free mice transplanted with human fecal microbiota.Genes involved in the transport of carbohydrates were found to be overrepresented concurrently by metagenomic analysis. Nevertheless,

following a week of returning to a typical chow diet, microbial populations reverted to their initial condition [Goodman et al. 2011]. [37]
According to Joshua Lederberg, who first presented the idea of the human microbiome to the scientific community, it is "the ecological community of commensal, symbiotic, and pathogenic microorganisms that literally share our body space and have been all but ignored as determinants of health and disease" [Lederberg and McCray, 2001]. Published research detailing the microbiota composition in healthy and ill human populations, as well as innovative techniques for data mining and comparative analysis of the data, have been gained since the Human Microbiome Project (HMP) began. A study that described the fecal microbial communities of adult twin pairs concordant for leanness and obesity revealed one fascinating finding [Turnbaugh et al. 2009]. [38]

Objectives:

- The Novel Nutraceutical supplement recovers gut epithelium morpho-histology.
- The gut microbiota can metabolize herbal medicines to produce new absorbable active small molecules which have active pharmacological effects. Also, herbal medicines can regulate the composition of gut microbiota and its secretions, then changed gut microbiota and its secretions play a therapeutic role.
- To investigate how gut motility, digestion, and microbiome balance are affected by various yogic practices (such as asanas and pranayama).

Research Methodology:
Ayurvedic classics, published information from several articles, e-database viz., PubMed, Science Direct were assessed for literature search. The key words searched were Triphala, Agni, obesity, gut microbiota, prebiotic, probiotics.

Result and Discussion:
Concept of basic nutraceuticals therapy in Ayurveda
Since ancient times, Ayurveda has made extensive use of nutraceuticals made from a variety of plant sources. Together with an appropriate ahara (dietary plan) and occasionally a rasayana, the herbal nutraceuticals are marketed as "Medical foods." These therapeutic foods are frequently only mentioned in relation to the Ayurvedic medical system. Table 1 elicits the characteristics and instances of these. Aside from these therapeutic foods, Ayurveda also prescribes the notion of Ahara and rasayanas, which play a general role in maintaining health and may thus be used in conjunction with herbal nutraceuticals or medicinal foods.
Ahara perception can be classified as follows: Patyampathonapetham (= emphasizes the significance of patyam in yapyarogas), Nithyamhithaaharaviharasevi (= emphasizes the prevention of diseases), Samadoshasamagnischa (= a particular approach in defining health by susrutha), or Hithahithamsukhamdukham (= everything that sustains, nurtures, and maintains the life). In contrast, Rasayanam ("Rasayanam cha tat jneyamyajjiaravyadhinasanam") aids in delaying the onset of illness and aging. Modern definitions of rasayana therapy, however, are more customized and particular to age, organ, and dhathu (tissue). Their primary effects are on rasa (pravala, satavari), and agni, which increases the activity of enzymes (pippali, sunti). Srothas: Enhancing the transport system, which includes the guggulu cell signaling mechanism.The degree to which an ahara becomes preventive or curative in traditional Ayurvedic medicine relies on the individual's prakriti, sara, and dosha as well as the amount of ahara and rasa. [39]

Table 1: The concept of medicinal food (= translating to modern herbal nutraceuticals)

Type of intervention	Property	Explanation	Ayurveda Example
Medicinal food	*Mando vathaanulomanam thirt glani dosha shodhanam pachano dhathu samya krthu*	formulated to be consumed or administered orally under supervision, haviving specific nutritional or curative intent	Krutanna varga, peya (thrustna, glani dourbhalya, kukshi roga, jwarahapa, malaanulopani, pathya, peya-(deepana pachani), Velepi-(velepi grhni hrudya trushna,agni deepani, hitha in vrana akshi roga shumsudda durbhala sneha paniyanam)

Hippocrates, the founder of contemporary western medicine, is well-known for saying that "every illness starts in the gut." Proper digestion and diet, along with all facets of lifestyle, are highly valued in Ayurveda. Ayurveda is regarded by some scholars as an ancient epigenetics science. Although the Ayurvedic practitioners were not familiar with the specific nutrigenomic mechanics of how food influences gene expression, they were aware that every person has a distinct psychophysiological constitution that is influenced by environmental factors, stress management, lifestyle, diet, and digestion.
Ayurveda uses the three primary doshas—Pitta, Kapha, and Vata—as the governing principles of physiology to explain how our minds and bodies function. We evaluated the studies on the physiological, biochemical, and genetic correlates of each dosha in a prior study. As we clarify, the Vatadosha group encompasses the systems that govern movement at all physiological levels, waste disposal, and cognition. [40]
According to Ayurveda, the colon, which contains the majority of the gut microbiota, is the main site of Vata. The midgut region is home to the pitta dosha, which is in charge of processes including digestion, metabolism,

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thermoregulation, and energy homeostasis. Kaphadosha, which is mostly found in the chest region, regulates the development and upkeep of structure. Each dosha type and gene expression differs significantly, according to genetic study. Cell cycle-related genes were upregulated in Vata types, while Pitta types had upregulated genes in immune response pathways, and Kapha types had upregulated genes in immunological signaling pathways. It is thought that each dosha type has a unique way of brain functioning.Assessing a person's Prakriti (the distribution of the three doshas at birth) is one of the first steps in Ayurvedic health evaluation. Furthermore, an evaluation is conducted of the Vikriti, or state of dosha equilibrium. Although a person may be born with a dominant VataPrakrti, an environmental circumstance may cause the major imbalance to be in Pitta at the time of diagnosis.
We demonstrate how the microbiota is essential to both Ayurveda and contemporary medicine in Figure 1. [41]

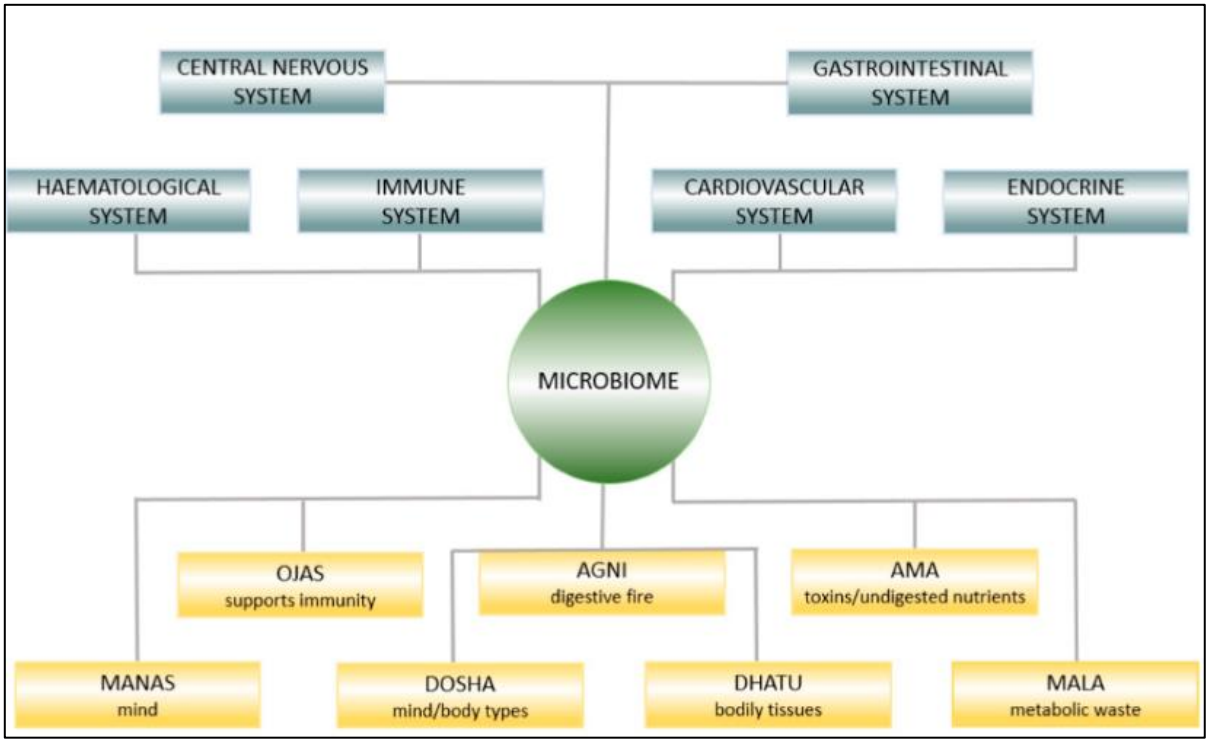

Figure 1. Ayurvedic anatomy affected by the microbiome.

Prakriti and Gut Bacteria
One study looked at the connection between microbiota makeup and Prakriti. Vata, Pitta, and Kapha are the three primary Prakriti types, and each had a distinct microbial composition, according to the study. The people under study shared food patterns and were from the same area. All of the participants' primary bacteria belonged to the phyla Firmicutes and Bacteroidetes. In less prevalent bacteria, there were clear distinctions between the Vata, Pitta, or Kapha families. For instance, there were more butyrate-producing bacteria in the extreme Pitta individuals, which may have helped shield them from inflammatory illnesses. Prevotellacopri, a kind of bacteria linked to rheumatoid arthritis and insulin resistance, was found in greater quantities in the extreme Kapha women.A more recent study examines the potential of the Prakriti idea as a gut microbiota stratifier. [42]

Potential impact of herbal-based nutraceuticals on gut microbiota:
A complex ecology of a trillion of microorganism living in the intestines, the gut microbiota is essential to human health. Recent studies indicate a close connection between its makeup and a number of medical disorders. Unbalances in the variety and function of the gut microbiota are directly connected to lifestyle disorders like diabetes, heart disease, and obesity. Furthermore, changing gut microbiota composition is linked to illnesses like irritable bowel syndrome and inflammatory bowel disease. The immune system is strengthened by a normal gut microbiota, whereas dysbiosis may make a person more vulnerable to autoimmune disorders and infections. As possible modulators of gut microbiota, herbal-based nutraceuticals—which are made from plants and used for their health benefits—are becoming more and more well-liked. According to recent studies, some herbs may have a beneficial effect on the composition of the gut microbiota, which could result in better health results. Research has indicated that some herbs, including chicory root, flaxseed, and turmeric, have prebiotic qualities. Prebiotics are indigestible fibers that act as nourishment for good gut bacteria. Prebiotics encourage the growth and activity of bacteria that are known to have beneficial effects on immune system and gut health, such as Lactobacillus and Bifidobacteria. Herbs having immunomodulatory or prebiotic qualities

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may have an impact on the gut microbial population as a whole, possibly changing its composition to one that is more health-promoting. Numerous physiological mechanisms connected to lifestyle disorders may be impacted in a cascade of ways.

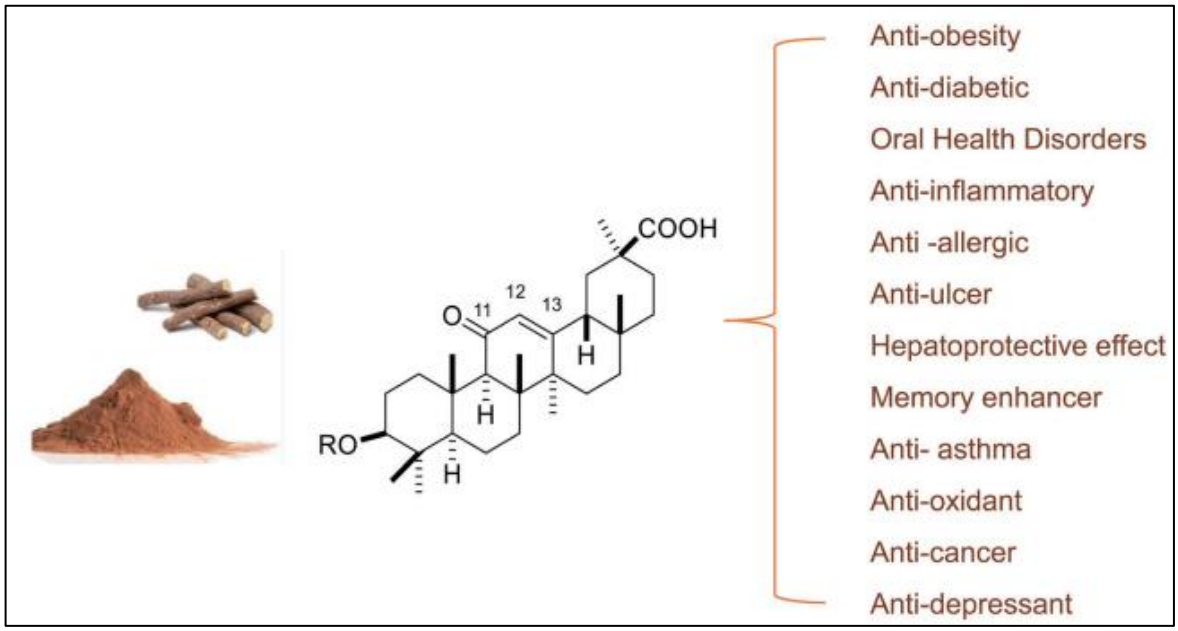

Figure 2: Licorice (Glycyrrhizaglabra) and its effects on lifestyle diseases

Certain herbs, such as neem, have antibacterial qualities that can help control the growth of potentially dangerous gut bacteria linked to metabolic dysfunction and inflammation. It is vital to remember that careless usage of these herbs can also destroy good bacteria, underscoring the significance of appropriate dosage and medical advice. Herbs having immunomodulatory qualities, such as ashwagandha, may affect the immune system in the gut and indirectly affect the makeup of the gut microbiota to lessen inflammation brought on by dysbiosis. Polyphenols found in some herbs, including green tea, may have antioxidant and anti-inflammatory properties in the stomach, possibly fostering the growth of good bacteria. According to recent studies, ginger and a herbal remedy called triphala may both enhance the function of the intestinal barrier, which is essential for controlling nutrient absorption and halting the entry of toxic chemicals into the bloodstream. The three fruits that make up triphala are Terminalia bellerica (Bibhitaki), Terminalia chebula (Haritaki), and Emblicaofficinalis (Amalaki). [43]
Novel approaches to the treatment of lifestyle disorders are made possible by the possible effects of herbal-based nutraceuticals on gut flora. To clarify the exact processes behind these possible advantages and to develop the best herbal treatments for enhancing gut health and lowering the risk of lifestyle diseases, more research is necessary. It's critical to recognize that the gut microbiota is a complex ecosystem that is impacted by a number of variables outside of herbal remedies. Individual lifestyle decisions, food habits, and pre-existing medical issues can also have a big impact.

Concept of Ayurvedic Nutraceuticals for Gut Health

The words "nutrition" and "pharmaceutics" are combined to form the phrase "nutritraceutical." The phrase refers to goods that are separated from herbal items, dietary supplements (nutrients), certain diets, and processed meals like cereals, soups, and drinks that are utilized as medicines in addition to being used for nourishment. A substance that has physiological benefits or offers protection against chronic disease might be categorized as a nutraceutical product. Nutraceuticals may be recommended to promote health, slow down the aging process, avoid chronic illnesses, prolong life, or boost metabolism. The potential nutritional, safety, and therapeutic impacts of nutraceuticals have drawn a lot of attention. Herbal nutraceuticals have a promising effect on oxidative stress-related noncommunicablediseases, such as obesity, Alzheimer's and Parkinson's disease, cardiovascular disease, cancer, diabetes, eye and immunological problems, and allergies.

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Ayurvedic Pharmacologic Notions for Modulation of Gut Mucosa (see Figure 3)

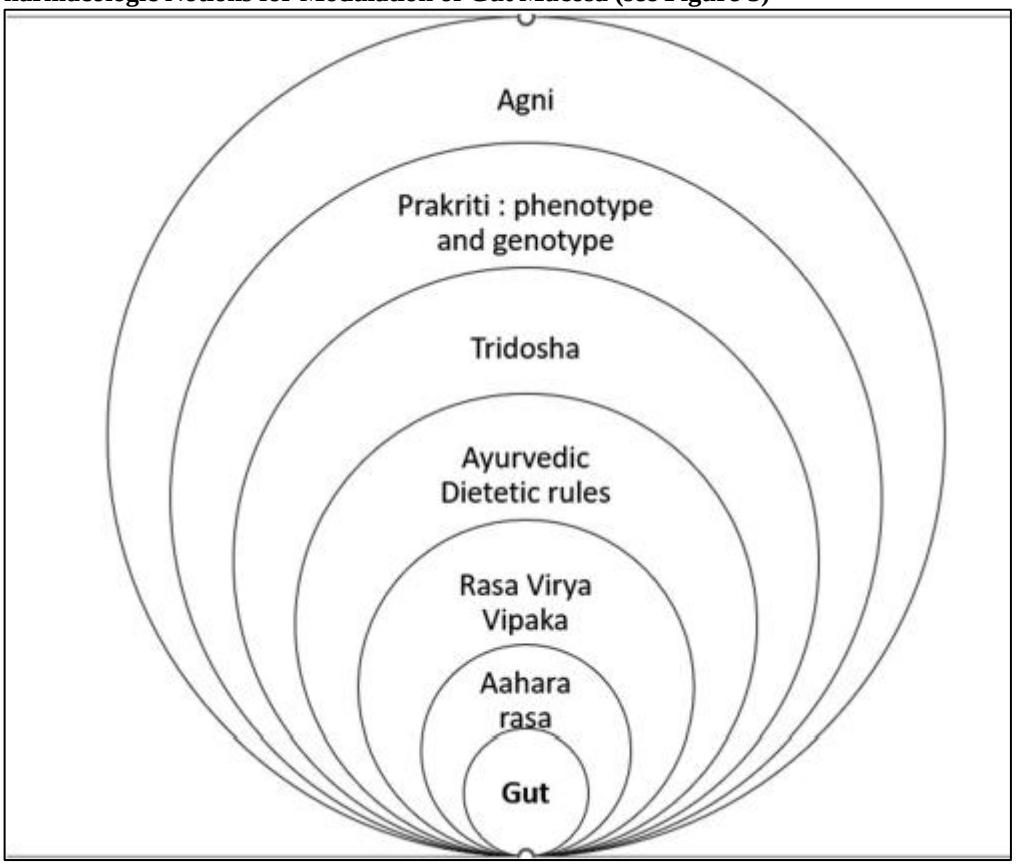

Figure 3:Ayurvedic gastrointestinal class of nutraceuticals: Impact on gut health.

- **Deepana: Pharmacological Expression of Nutraceuticals for Enhancing Gut Microbiome Activity:**

The word "Deepa," meaning "kindling the fire," is used to elaborate the term Deepana. "Deepana" refers to the food, medication, or procedure that promotes digestion. Before food is even consumed, the Deepana procedure stimulates digestion on a fundamental level. An essential aspect of health is the metabolism and digesting processes. Agni impairment, whether qualitative or quantitative, is the root cause of all illnesses.18 The goal of Deepana activity is to maintain the balance between Agni and the stomach. Factors that promote digestion can be used to study the Deepana effect. Eating Deepana cuisine may boost the levels of digestive hormones such as cholecystokinin, secretin, and gastrin.More precisely, it appears that the hormones leptin and ghrelin are crucial in creating the Deepana effect.

- **Pachana: Pharmacological Expression of Nutraceuticals to Enhance Nutrient Absorption through Effective Digestion**

In reality, "Pachana" denotes "digestion," "cooking," and "boiling." It indicates or encourages digestion in therapeutic settings. It is a precondition for purifying treatments and is intended to eliminate undigested food and poisons (Ama) from the body. It is recommended for Dosha pacification. The primary and secondary metabolism at the organic and cellular levels may be impacted by foods and medications that have a Pachana effect. Pachana meals and herbs are thought to speed up the main metabolic and biochemical process. The food conversion ratio is utilized in experimental investigations to objectively evaluate the Pachana activity of medications. The gram percentage (gm%) of food ingested is determined by dividing the gm% of fecal matter that was passed on the same day.Increased nutritious content (sarabhaga) and a consequent drop in waste products (kittabhaga) are the results of improved metabolism. Therefore, a better food conversion ratio may be the outcome of pachana.

- **Anulomana: Therapeutic Rejuvenation of the Colon Microbiome**

The term "anulomana" refers to the gentle or kind physiological discharge through the closest outlet. Ayurvedic scriptures say that anulomana is a good way to maintain gut health. It has been demonstrated that dysbiosis, or a reduction in the gut microbiome, can result in hard, dry stools and irregular bowel patterns. Improper stool evacuation is intimately linked to VataDosha disorders and is seen as a major barrier in mahastrotasa. This obstruction affects both mental and physical health and causes Ama circulation. Herbs in the anulomana family help the microbiota with appropriate excretion, loosen the stools, and encourage active peristalsis for expulsion. The colon mucosa can benefit

from the use of herbs such as Yashtimadhu (Glycyrrhizaglabra), Jeeraka (Cuminumcyminum), Balharitaki (Terminalia chebula), Ajamoda (Ptychotisajowan), and rock salt. It is commonly known that these herbs work effectively as mild laxatives.

The Future of Ayurveda Nutraceuticals in Therapeutic Gut Modulation

Medicine is undergoing a period of upheaval in the health sector and related research (see Figure 4). Emerging research will aid in improving the decisions made by medical science. Since integrative medicine blends the best aspects of traditional natural health systems like Ayurveda with the best aspects of contemporary medicine, it is a significant achievement. [44]

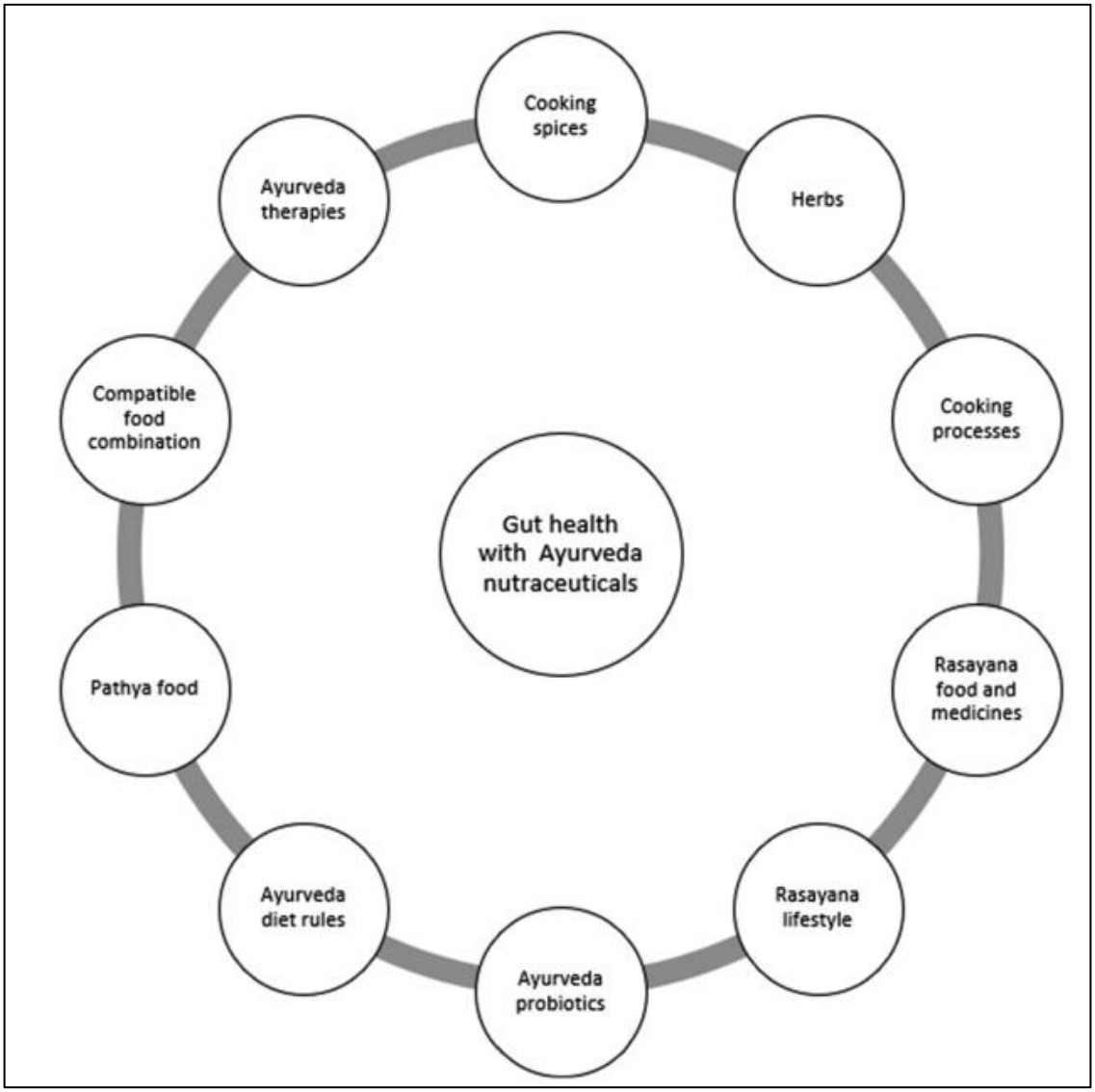

Figure 4: Holistic application of Ayurvedic nutraceuticals for gut modulation.

Conclusion:

Since it is known that gut microorganisms can manufacture nutraceuticals, there is a growing need to comprehend the relationship between the gut microbiome and nutraceuticals in order to use gut microbes to produce them. Digestive Fire: According to Ayurveda, a healthy digestive fire is necessary for our gut to break down food, produce energy, and eliminate waste. Health and proper digestion depend on a balanced agni. Digestive Health Is Important: We feel better, have more energy, and are less prone to illness when our gut is healthy.

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