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Research in the Treatment of Essential Oil of Traditional Chinese Medicine through Gut Microbiota to Related Diseases

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Abstract: *Gut Microbiota, as a major bacterial barrier in organisms, regulates a variety of important functions of the digestive system. Researches have shown that Gut Microbiota is also closely related to human metabolism, immunity, nerve conduction and other physiological activities, and is involved in maintaining people's life and health. At the same time, the imbalance of Gut Microbiota is also significantly related to the occurrence of multi system diseases in the human body, which can directly or indirectly affect the normal metabolism and biological barrier, and then lead to the disease of the body. As an extract of traditional Chinese medicine, it uses different properties, tastes, meridian tropism and pharmacological effects to realize the regulation of Gut Microbiota imbalance, so as to affect and regulate the related diseases caused by Gut Microbiota imbalance. After searching a large number of literatures, this review summarizes the regulatory relationship between Gut Microbiota and related diseases, and the treatment of related diseases by using Gut Microbiota with traditional Chinese medicine essential oil.*

Keywords: *Gut Microbiota, Dysbacteriosis. Diseases, essential oil of traditional Chinese Medicine*

1. Introduction

Gut Microbiota, a large number of microorganisms living in the human gastrointestinal tract, affects not only the gastrointestinal tract but also the physiological health of different systems such as the central nervous system, endocrine system and respiratory system. Many studies have proven that Gut Microbiota is involved in the development of many diseases through multiple pathways. By extracting volatile oils from Chinese herbal medicines and making them into safe and widely used essential oils, such as pepper essential oil, cinnamon essential oil and lemon essential oil, we can regulate Gut Microbiota and improve the treatment of diseases caused by the imbalance of Gut Microbiota. This article focuses on the effects of Gut Microbiota on the treatment of intestinal diseases. This article reviews the mechanism of action of Gut Microbiota on a variety of diseases, and the therapeutic effects of some essential oils on Gut Microbiota.

2. Gut Microbiota and many diseases

Gut Microbiota is an important flora regulatory system that connects the body's health with the external environment and is an important barrier to maintain human health. The number of Gut Microbiota reaches up to 1000 species, and the main flora consist of thick-walled bacteria, \Bacteroidetes, Actinomycetes and Aspergillus. Under normal physiological conditions, they are mutually regulated to form an intestinal homeostasis. When the intestine is affected by age, diet, environment, race, and the evolution of microbial communities and their hosts [1], the intestinal homeostasis is disrupted, resulting in dysbiosis of Gut Microbiota, which in turn affects the normal physiological metabolism, regulation of immune function, neurological signalling and other physiological functions of the human body, thus participating as the predisposing factors of major diseases[2].

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2.1. Gut Microbiota and digestive disorders

The digestive system is a tube that runs from the mouth to the large intestine and anus, and there are significant differences in the composition, number and function of the flora in the major tissues of the digestive system as they vary in structure. A growing body of research has shown that dysbiosis is associated with inflammatory bowel disease, irritable bowel syndrome (IBS), colorectal cancer and other digestive disorders.

Irritable bowel syndrome (IBS) is a common functional gastrointestinal disorder. Its main symptoms are abdominal pain and bloating, often accompanied by changes in bowel habits such as constipation and diarrhoea [3]. The dysbiosis of Gut Microbiota disrupts the physiological balance of the body through several possible mechanisms, such as affecting intestinal dynamics, causing cardiac hypersensitivity, disrupting the intestinal mucosal barrier and affecting the brain-gut axis information transmission, leading to an imbalance in intestinal homeostasis, which in turn becomes an important factor in triggering IBS, resulting in clinical symptoms of IBS such as diarrhoea and abdominal distension [4]. Therefore, improving Gut Microbiota can effectively reduce the clinical symptoms of IBS and improve the quality of life of patients.

Inflammatory bowel disease (IBD) is a group of chronic and recurrent inflammatory diseases of the intestine caused by multiple etiologies, including the subtypes Crohn's disease (CD) and ulcerative colitis (UC). IBD is characterised by diarrhoea, acute abdominal pain and intestinal obstruction, as well as extra-intestinal damage to the eyes, oral mucosa and joints [5]. It has been shown that Gut Microbiota is a key factor in the development of IBD, and is an important target for drug research in the treatment of IBD [6]. Sun et al[7] showed that the distribution of Gut Microbiota was significantly different between IBD patients and normal subjects, with a significant increase in thick-walled bacteria and actinomycetes and a significant decrease in amoebae. Various studies by Goncalves et al [8] have found that the intestinal flora and its metabolites can play a key role in the pathogenesis of IBD by impairing the intestinal mucosal barrier and inducing an immune response in the body. Peng et al[9] showed that for the treatment of IBD, probiotic supplementation can effectively inhibit the growth and reproduction of pathogenic bacteria in the intestinal tract, reduce the apoptosis of epithelial cells and increase the thickness of the intestinal mucosal layer to enhance the intestinal mucosal barrier, maintain the homeostasis of the body's ecological immunity and reduce the occurrence of inflammatory response.

2.2. Gut Microbiota and endocrine system diseases

The prevalence of endocrine disorders is increasing with the development of today's society and the improvement of living standards. The most common clinical endocrine disorders include diabetes, obesity and non-alcoholic fatty liver disease. Gut Microbiota is a major component of the body's environment, not only for digestion and absorption, but also as the largest microbiological system, immune organ and detoxification organ in the body [10]. Therefore, Gut Microbiota plays a major role in endocrine metabolic diseases such as diabetes and obesity.

Diabetes is a global health problem with a high prevalence and mortality rate and the burden of medical costs is a major challenge for many families. The bile acid theory, the short-chain fatty acid theory and the endotoxin theory all suggest that the metabolism of sugars, fats and amino acids by Gut Microbiota is relevant to the pathogenesis of diabetes.

After experiencing the threat of cardiovascular disease and cancer to the health of all human beings, obesity has become an increasing threat to the health of the organism, as the third most common disease [11]. Nowadays the prevalence is gradually increasing, as obesity can cause fatty liver, diabetes, hypertension, hyperlipidemia and many other metabolic diseases [12], which seriously affects people's life health and quality of life. Turnbaugh et al [13] showed that germ-free mice had increased body fat after colonisation of Gut Microbiota of obese mice, which could promote obesity formation. It also showed that Gut Microbiota of obese mice had a higher capacity for energy absorption. Buyzguri-Tursun et al [14] showed that obesity may result from the production of intestinal metabolites being affected by dysbiosis of Gut Microbiota.

2.3. Gut Microbiota and neurological disorders

The famous "brain-gut axis" theory refers to the fact that this network system works through the coordination of the nervous system and the gut flora to "communicate" together [15]. Zhou et al[16] showed that the effects of gut flora on the central nervous system are mediated through a variety of pathways,

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including the brain-gut axis, which affects neurotransmitter levels and other important processes that regulate the development of the nervous system. In addition, a large number of studies on the regulation of the nervous system by Gut Microbiota have revealed that dysbiosis may be significantly associated with the development of neurological diseases such as Parkinson's, Alzheimer's and depression.

Parkinson's disease (PD) is a degenerative disease in the central nervous system. The main clinical manifestations are typical motor symptoms such as bradykinesia and myotonia, and non-motor symptoms such as sensory impairment and cognitive impairment [17]. Liu et al[18] showed that dysbiosis of Gut Microbiota could reduce the short chain fatty acids (SCFAs) flora, altering the permeable membrane of the intestine and spreading to the brain, triggering Parkinson's-related symptoms.

Alzheimer's disease (AD) is a common progressive neurodegenerative disease. Clinical manifestations include motor symptoms such as bradykinesia and myotonia, as well as non-motor symptoms such as cognitive impairment and senile plaques, and even symptoms of dementia [19]. Gut dysbiosis may cause immune and neurological inflammatory responses by increasing the permeability of the gut barrier and blood-brain barrier, and may also cause cognitive impairment in AD patients by decreasing the levels of γ-aminobutyric acid (GABA), acetylcholine (ACH) and other The symptoms associated with AD may also be caused by reduced levels of GABA and ACH [20].

Depression is a common and multifaceted psychiatric disorder with clinical manifestations such as marked and prolonged mental depression and cognitive dysfunction caused by various factors [21,22]. Guo et al [23] showed that intestinal dysbiosis may affect the immune and central nervous systems through endocrine and vagal pathways, resulting in bidirectional regulation of the gut-brain axis, mainly involving immune response mechanisms, monoamine neurotransmitters and the hypothalamic-pituitary-adrenal axis [24]. In the same way, regulating intestinal homeostasis, restoring normal nerve signalling and reducing the immune and inflammatory response can promote neurological recovery and achieve the treatment of depression.

2.4. Gut Microbiota and respiratory diseases

Respiratory diseases are among the most common clinical conditions and have a high prevalence. The link between Gut Microbiota and respiratory diseases has been tightened due to the proposed theory of pulmonary-intestinal-axis research.Gut Microbiota and pulmonary microorganisms can cross-act to regulate flora homeostasis, immunity and inflammation and are involved in influencing the development or treatment of disease [25]. Respiratory diseases such as respiratory infectious diseases and bronchial asthma have been associated with gut flora.

Since the respiratory tract is connected to the outside world and is responsible for the inhalation and expulsion of gases, it is also exposed to a variety of microorganisms such as bacteria, fungi and viruses, which can cause respiratory or lung infections if the respiratory barrier is breached. Respiratory infections can occur due to pathological changes in two ways. On the one hand, immune response errors in the clearance of harmful pathogens by the immune system of the intestinal mucosa disrupt intestinal homeostasis, resulting in metabolic dysfunction as well as inflammatory reactions and more difficult clearance of pathogens; on the other hand, dysbiosis of Gut Microbiota may occur as a result of antibiotic administration, which in turn may exacerbate respiratory infections [26]. Asthma is an allergic disease of the airways and the main clinical symptoms are sudden and severe coughing and wheezing, with chest tightness and shortness of breath [27]. Asthma may increase the risk of asthma in children due to maternal use of antibiotic drugs during pregnancy [28], and also due to an increase in the relative abundance of Bacteroides and total anaerobes in Gut Microbiota [26].

2.5. Gut Microbiota and reproductive disorders

Polycystic ovarian syndrome (PCOS) is a common reproductive disorder characterised by hyperandrogenemia, abnormal ovulation and other symptoms such as insulin resistance [29]. The disruption of Gut Microbiota and disruption of the intestinal barrier can affect serum testosterone levels and lead to hyperandrogenemia, as well as chronic inflammatory responses through the production of lipopolysaccharides, endotoxins and pathogenic bacteria [30,31].Liu et al [32] found that the relative abundance of thick-walled and bacteriophage flora in Gut Microbiota of patients with PCOS increased, compared to the normal Gut Microbiota, and also It can also affect oligo-teratospermia [33], reproductive disorders such as endometriosis [34] and tumours [35].

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3. Herbal oils for the treatment of related diseases through Gut Microbiota

Essential oils, which are volatile oil components of Chinese herbal medicines distilled or extracted by water [36], are widely found in Chinese herbal medicines and most of them are aromatic, diverse, safe and have a wide range of action. They are traditionally used orally, in moxibustion, aromatherapy and pillows [37], and are now often complemented by physical therapy such as tui na [38] and acupuncture [39] to promote synergistic effects. In this review, the more commonly used clinical herbal oils such as pepper oil, cinnamon oil and lemon essential oil are mentioned.

3.1. Essential oils and endocrine system disorders

Pepper essential oil, a volatile oily liquid with a natural pungent flavour, is extracted from plants of the Rutaceae family [40]. Ren et al [41] showed that pepper essential oil could improve the microenvironment of Gut Microbiota by increasing the abundance of bifidobacteria and lactobacilli, decreasing the abundance of harmful bacteria such as Escherichia coli, and increasing the production of short-chain fatty acids, through studies on the pathogenesis of type I diabetes. On the other hand, it was shown that pepper essential oil improved the hypertrophy of cecum tissue caused by diabetes and reduced the damage to the cecum epithelium by reducing the surface area of the cecum and the ammonia content of the cecum, which promoted intestinal health and also effectively achieved the therapeutic effect of hypoglycaemia. Xiao et al[42] demonstrated that the intake of cinnamon essential oil can reduce the relative abundance of pathogenic bacteria in the intestinal tract and inhibit their transfer in the oral cavity, regulate the redox balance in the intestinal tract, and effectively prevent or treat diabetes and obesity.

3.2. Essential oils and diseases of the digestive tract

Lychee belongs to the genus Lychee fruit of the family Lycheeidae, a medicinal food plant, and the main component of Lychee essential oil is Lychee polyphenols. Zhang et al [43] found that lychee polyphenols can regulate intestinal probiotics, reduce oxidative stress, as well as inhibit lipase activity eventually played a castor oil diarrhea model mice antioxidant, anti-diarrheal effect, for the irritable bowel syndrome of diarrhea has a good therapeutic effect.

3.3. Herbal oils and central nervous system disorders

Rhodiola rosea, a plant of the family Rhodiola Roseae, has the effect of benefiting the vital energy and blood circulation, as well as clearing the veins and calming asthma. The main active ingredient of its essential oil is rhodiroside. Wang et al[44] showed that rhodiroside may reduce microglia activation through the bacterium-gut-brain axis, and also reduce the level of pro-inflammatory factors, which can eliminate Clostridium perfringens flora as well as streptococci to improve the intestinal microenvironment, thus reducing symptoms such as cognitive impairment and memory impairment in AD. Li et al [45] found that turmeric essential oil could express antidepressant-like effects by regulating Gut Microbiota.

3.4. Chinese herbal oils and respiratory diseases

Bitter almond, which has the effect of lowering gas, relieving cough and asthma, and laxative effect, its essential oil is mainly composed of bitter amygdalin. Du and others[46] showed that bitter amygdalin can be metabolized by Gut Microbiota and one of its hydrolysis products, hydrocyanic acid, can calm asthma and effectively treat bronchial asthma and other diseases by inhibiting the respiratory centre.

Astragalus essential oil is mainly composed of astragaloside and other active ingredients. Sun et al[47] showed that astragaloside can be hydrolysed by Gut Microbiota, and then astragaloside and its metabolites can be circulated through the bloodstream to inhibit the occurrence of respiratory intestinal inflammatory response, and play a role in relieving cough and asthma. In addition, astragaloside has significant antiviral effects and can inhibit respiratory tract infections as well as influenza viruses to a certain extent [48].

3.5. Chinese herbal oils and reproductive disorders

Glycyrrhiza glabra, has the properties of tonifying the spleen and benefiting the qi, relieving urgency and pain. The main components of its essential oil are total glycyrrhizin and glycyrrhizin. Wang et al[49]

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found that the total saponin and aqueous extract of Glycyrrhiza glabra could regulate the relative abundance of Trichosporon and Bacillus mimicus and Lactobacillus, promote the growth of beneficial bacteria and improve the dysbiosis of Gut Microbiota. And Jiang et al[50] showed that glycyrrhizin could regulate hormone secretion and conversion, reduce testosterone content, increase the number of corpus luteum, etc. To treat hyperhormonemia, improve ovarian quality and histomorphological abnormalities as well as ovulation abnormalities in rats with letrozole-induced PCOS.

4. Discussion and outlook

The composition of essential oils in Chinese medicine is complex and their effects are diverse. Some essential oils can affect a variety of diseases through multiple targets and pathways, and there is still great potential for the development of essential oils, while some essential oils are undeveloped or underdeveloped and have fewer applications overall. In addition, the relationship between Gut Microbiota and multiple systemic diseases has been well established and can affect related diseases through multiple pathways such as metabolism, immunity, neurotransmission, gut-brain axis, lung-brain axis, etc. However, the etiology of many diseases is not yet fully understood and more evidence is needed to further investigate the use of essential oils to treat or improve related diseases through the regulation of Gut Microbiota.

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