Proceedings of ICBioMed 2025 Symposium: AI for Healthcare: Advanced Medical Data Analytics and Smart Rehabilitation
DOI: 10.54254/2753-8818/2025.AU24398

Research Progress on the Treatment of Type 2 Diabetes by Regulating Intestinal Flora with Dendrobium Officinale Polysaccharides

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Abstract. Dendrobium officinale Polysaccharides (DOPS), as an important medicinal active ingredient, has shown a unique multi-regulatory effect in the treatment of type 2 diabetes. This essay attempts to point out the modulation of intestinal microbiota through Dendrobium officinale polysaccharides for the treat of type 2 diabetes. Different from the traditional drug treatment of type 2 diabetes, Dendrobium officinale polysaccharide-intestinal microbiota treatment can not only avoid the problem of drug resistance, but also treat a variety of other illnesses of type 2 diabetes and restore the intestinal environment and a variety of balance in the human body to prevent other symptoms. In conclusion, the effect of Dendrobium officinale polysaccharides on intestinal microbiota for the treat of type 2 diabetes is an innovative and effective strategy with important clinical practical value.

Keywords: type 2 diabetes, dendrobium officinale polysaccharides, Intestinal flora, progress

1. Introduction

Type 2 diabetes has become an extremely serious public health problem worldwide. At present, the amount of sick person with type 2 diabetes has exceeded 537 million. At present, the conventional treatment methods for type 2 diabetes mainly include lifestyle intervention, oral hypoglycemic drugs (such as sulfonylurea drugs, metformin drugs, etc.) and insulin injection. These drug methods will inevitably lead to side effects and drug resistance in patients.

Meanwhile, the intestinal microbiota, as an important microbial community in the human body, has received extensive attention due to its close relationship with various metabolic diseases. A variety of studies have shown that intestinal flora imbalance is not only one of the important triggers for the onset of type 2 diabetes, but also can have a significant impact on the disease through multiple pathways such as metabolites and inflammatory responses. Against this background, this article explores a novel treatment approach, that is, by regulating the composition of the intestinal flora, etc., hoping to avoid various complications that occur during the handling of type 2 diabetes as much as possible and lay the groundwork for the future treatment of patients.

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Dendrobium officinale polysaccharides, as a natural active ingredient, have a significant hypoglycemic effect in the application of traditional Chinese medicine. Studies have shown that Dendrobium officinale polysaccharides can regulate the makeup of the intestinal flora, influence the metabolites of the flora and other means to repair the intestinal barrier and inhibit further inflammatory responses. Therefore, this article hopes to utilize Dendrobium officinale polysaccharides, an excellent and effective traditional Chinese medicine component, to regulate the metabolism and composition of the intestinal flora, in order to achieve the purpose of treating type 2 diabetes, reducing the occurrence of other illnesses and improving the patient's physical condition.

This article will start from at present situation of type 2 diabetes and combine the relation between intestinal flora and type 2 diabetes to explore the mechanism of action of Dendrobium officinale polysaccharides in treating type 2 diabetes through intestinal flora, aiming to provide a reference for the modernization development of conventional Chinese medicine in the field of metabolic diseases.

2. Type 2 diabetes

Type 2 diabetes, as a metabolic disease, is mainly caused by insulin resistance and dysfunction of pancreatic beta cells.

2.1. The current situation of Type 2 diabetes

According to the report of the International Diabetes Federation, the number of type 2 diabetes patients worldwide has currently exceeded 537 million [1].

The main reason for the emergence and continuous increase of this figure is the combined effect of three problem factors, namely, the continuous increase in the prevalence rate of type 2 diabetes, the insufficient popularity of related effective treatment methods, and the lack of corresponding prevention strategies. Type 2 diabetes, under the combined effect of these multiple factors, has become a public health challenge that has to be faced seriously.

2.2. Current treatment methods for 2 diabetes

At present, the conventional treatment methods for type 2 diabetes mainly include lifestyle intervention, oral hypoglycemic drugs (such as sulfonylurea drugs, metformin drugs, etc.) and insulin injection.

However, while undergoing treatment, the side effects of these treatment methods cannot be ignored. Long-term use of oral medications and insulin injections can cause new health problems for patients, such as upgraded drug resistance, impaired internal environment of patients, poor patient compliance, and the neglect of complications of type 2 diabetes, among many other new issues.

Therefore, this paper proposes a novel idea, the aim of which is to improve the other illnesses of the intestinal flora in the body and repair the intestinal environment through the traditional Chinese medicine Dendrobium officinale polysaccharides, while type 2 diabetes and its complications are treating and alleviating. and improving the physical fitness of patients for subsequent other treatments.

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3. New ideas on the relation between Gut Microbiota and Type 2 diabetes

3.1. Intestinal flora

The intestinal microbiota is a microbial community existing in the mankind intestinal tract, mainly containing bacteria, fungi and viruses, etc.

3.1.1. The role of intestinal microbiota

The gut microbial community generates a lot of beneficial metabolites through metabolic activities, including short-chain fatty acids and vitamins, etc. The metabolites produced have an important impact on the host's energy metabolism and immune regulation.

3.1.2. Metabolites of the intestinal flora

The gut microbial community can regulate the metabolic function of the host through the "gut - microbiota - host" axis [2].

Specifically, the beneficial intestinal flora can activate G protein-coupled receptors by producing short-chain fatty acids, thereby improving the problem of insulin sensitivity [3]. Meanwhile, pathogenic germs in the intestinal tract can also produce lipopolysaccharides, which can trigger a systemic inflammatory response through the signaling pathways created by Toll-like receptors, thereby intensifying the insulin resistance effect [4].

In addition, the disruption of the intestinal obstacle function will also rise the transfer of endotoxins into the bloodstream, leading to a further aggravation of diabetes [5].

3.2. The association between the imbalance of intestinal flora and the onset of type 2 diabetes

A variety of researches have shown that intestinal flora imbalance is one of the important inducing factors for the onset of type 2 diabetes. In the bodies of sick people with type 2 diabetes, the composition of the intestinal microbiota has undergone drastic changes, mainly manifested as an imbalance in the proportion of microbiota (such as Bacteroides and Firmicutes) [6], a significant reduction in beneficial bacteria, and a substantial increase in pathogenic bacteria.

4. The mechanism by which Dendrobium officinale polysaccharides lower blood sugar and improve glucose metabolism

Dendrobium officinale is a precious traditional Chinese medicine under key protection in China and has been ranked first among the "Nine Immortal Herbs of China" since ancient times. The stem of Dendrobium officinale is a traditional Chinese medicine with a long history of nourishing Yin. It has a sweet and slightly cold nature and belongs to the stomach meridian and kidney meridian. Dendrobium officinale has had good therapeutic effects since ancient times.

Dendrobium officinale polysaccharides are important active components in Dendrobium officinale. They are mainly composed of monosaccharide molecules such as glucose, galactose and arabinose, which are linked together through glycosidic bonds. The structural characteristics of the polysaccharides in Dendrobium officinale are its highly branched polysaccharide chains and abundant and diverse side chain groups.

A variety of studies have shown that the polysaccharides of Dendrobium officinale can effectively and significantly lower blood sugar. Dendrobium officinale polysaccharides can improve

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insulin resistance by regulating the secretion of glucagon and insulin by pancreatic alpha and beta cells, thereby exerting a special hypoglycemic effect [7].

Research has found that Dendrobium officinale polysaccharides can more effectively act as prebiotics to promote the manufacture of short-chain fatty acids by the microbiota, thereby regulating sugar metabolism [8]. Here, this article speculates that the polysaccharides of Dendrobium officinale may further promote the secretion of insulin by pancreatic beta cells to maintain the stability of blood sugar by influencing the signal transduction module between the intestine and the islets.

5. The basic principle of dendrobium polysaccharide for the treatment of type 2 diabetes

5.1. Dendrobium polysaccharide regulates intestinal flora

5.1.1. Dendrobium regulates blood sugar in intestinal flora

Experiments show that iron-skin dendrobium water extract and its polysaccharide can reshape the homostaism of intestinal flora, regulate the relative abundance of bacteria related to blood sugar control and immune activity in the intestine, reduce inflammation, and inhibit the activity of glycosyl hydrolysis enzyme in the intestine, which can effectively reduce the rate of glucose entering the blood [9].

5.1.2. The functional role of dendrobium polysaccharide in the intestinal flora

Dendrobium polysaccharide (DOP) shows a unique multi-regulation effect in the treatment of type 2 diabetes (T2MD). Dendrobium polysaccharide can directly improve insulin resistance by using a multi-target regulation mechanism. Metabolic intervention mediated by intestinal flora protects the function of pancreatic islet beta cells, and can also reshape the ecology of intestinal flora. Give full play to the indirect blood sugar-lowering effect. DOP has a multi-target effect of using a single component to achieve the effect of lowering sugar, lipid regulation and caring for the intestine, better than other single-channel drugs.

5.2. The composition and mechanism of dendrobium polysaccharide regulating intestinal flora

DOPs is conducive to the control of blood sugar by regulating the intestinal flora, reducing the number of conditional pathogenic bacteria, reducing the permeability of the intestine, reducing the entry of toxic substances into the blood circulation, and reducing the inflammatory reaction of the body, which is conducive to the control of blood sugar, and thus plays a therapeutic role in type 2 diabetes.

5.3. The current situation of clinical treatment

At present, Such as clinical trials of dendrobium officinale for the treatment of type 2 diabetes have made some progress, but many challenges remain. the research on dendrobium polysaccharide is more focused on animal experiments than clinical. Certain differences exist between the animal model and the actual situation of the mankind body. The clinical manifestations of Dendrobium officinale in animals include: Dendrobium officinale polysaccharides can significantly reduce fasting blood glucose and hemoglobin A1c, lower the HOMA-IR index. They also decrease serum triglycerides, all cholesterol, and low-density lipoprotein, while rising high-density lipoprotein.

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Additionally, they reduce the release of pro-inflammatory factors, enhance antioxidant enzyme activity, and alleviate chronic low-grade inflammation associated with diabetes. Experimental evidence has demonstrated that Dendrobium officinale polysaccharides can ameliorate antibiotic-induced intestinal microbiota dysbiosis in mice. The composition and structure of intestinal microbiota in the Dendrobium officinale intervention group were the same to those in the normal control group. In contrast with the model group, a lot of beneficial bacteria such as Lactobacillus and Bifidobacterium, significantly increased in the Dendrobium officinale intervention group, while the abundance of harmful bacteria, like Desulfovibrio significantly decreased. These findings indicate that Dendrobium officinale polysaccharides can effectively improve antibiotic-induced intestinal microbiota dysbiosis in mice. Transform in the function and composition of gut flora are important causes of type 2 diabetes. Some prebiotics can reduce insulin resistance, such as fructooligosaccharides combined with probiotics to increase SCFAs concentration by 3-5 times. These studies have shown that dendrobium can improve T2MD through microbial metabolism and immunity, but human clinical trials are limited. Available clinical efficacy data show that the intervention of Dendrobium officinale can improve glucose tolerance and improve symptoms of diabetic peripheral neuropathy. The incidence of adverse reactions in the experiment was low, and serious adverse reactions were determined to be unrelated to the study drug, mainly digestive system reactions such as mild diarrhea and abdominal distension. Experimental studies can be optimized by using the design of applicable clinical trials and more realistic patient data to supplement background information. In the direction of action mechanism, although we have verified that dendrobium polysaccharide affects intestinal metabolic inflammatory reaction and insulin resistance through intestinal flora, it is still More research and experiments are needed to further explore the clinical feasibility of this method. The future direction of clinical research needs to focus on precise exploration: adjusting the dosage based on genetic diversity. The use of combination therapy with SGLT2 inhibitors has a protective effect on the kidney. In China, many brands have been helping to research the drugs of dendrobium polysaccharide and acting in the auxiliary treatment for type 2 diabetes. Due to the unique pharmacological rationality of iron dendrobium, traditional Chinese medicine often uses it to regulate gastrointestinal health, which is a traditional Chinese medicine with great research value and application prospects.

5.4. Market orientation

Due to the long-term consumption of traditional drugs leading to other intestinal issues, hypoglycemia, or imposing greater economic burdens on patients, natural Chinese herbal medicines like Dendrobium officinale have gradually gained attention and are currently under continuous research. In recent years, consumer acceptance of traditional Chinese herbs has steadily increased, with Dendrobium officinale being used as a health supplement and auxiliary medication for type 2 diabetes in the Asia-Pacific region. Seoul National University in South Korea, for example, studied a combination of dendrobium and Korean red ginseng to improve insulin sensitivity. The European and American markets have seen significant growth, primarily due to its role in supplementing dietary fiber They asked for data on modern clinical safety although they have a history of traditional herbal applications but Western physicians rarely consider adding dendrobium officinale as an adjunctive drug for treatment, mainly because of the unknown effects of the drug. Currently, Dendrobium officinale polysaccharides, as the core component, have been developed into capsules or tablets, and their combination with probiotics in compound formulations shows strong synergistic effects in lowering blood sugar. However, its authority and scientific validity still require extensive clinical trials for further validation. As demand for Dendrobium officinale rises, wild populations

DOI: 10.54254/2753-8818/2025.AU24398

may not be sufficient to meet the demand, and the polysaccharide content and activity of artificially cultivated strains could significantly decrease. Additionally, it is necessary to establish technical barriers for extracting Dendrobium officinale to increase production. At the same time, public awareness of the mechanisms of action of Dendrobium officinale polysaccharides needs to be enhanced to help consumers make better purchases of related products and avoid exaggerated claims. In the future, through joint clinical trials by pharmaceutical companies and medical institutions, combined with targeted marketing strategies for patients with prediabetes and the health market, Dendrobium officinale is expected to secure a more significant market share in T2MD management.

6. Conclusion

In recent years, there has been a rising number of diabetic patients, and in various countries, the treatment of Western medicine has been accompanied by some side effects. Therefore, the polysaccharides in Dendrobium officinale can effectively inhibit the occurrence of some side effects, and we studied its structure and composition to analyze the formation of type 2 diabetes and the therapeutic effect of Dendrobium officinale on diabetes. Dendrobium officinale can regulate the structure of the microbiota, enhance the intestinal barrier function, promote the production of metabolites and adjust the host insulin signaling pathway. Systematic studies have confirmed that DOP can not only directly improve insulin resistance and protect the function of pancreatic islet β cells, but also exert indirect hypoglycemic effects by reshaping the intestinal flora ecology. DOP can significantly improve glucose metabolism indexes, and its mechanism of action involves the regulation of signaling pathways at the molecular level, the improvement of metabolic function at the cellular level, and the homeostasis reconstruction in the microenvironment at the system level

In the future, our research should focus on the relationship between DOP structure modification and activity, the optimization of clinical dosing regimens, and the synergistic effect with other hypoglycemic drugs. With the deepening of research, DOP is expected to be developed into a new anti-diabetic drug with Chinese characteristics, providing more options for diabetes prevention and treatment.

Authors contribution

All the authors contributed equally and their names were listed in alphabetical order.

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