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Research Progress on the Ingredients, Pharmacological Effects, and Clinical Applications of Tongmai Jiangtang Capsule

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ABSTRACT
Tongmai Jiangtang Capsule (TJC) is a compound preparation that consists of 11 traditional Chinese herbs, which have the effects of clearing heat, promoting blood circulation, nourishing Yin, and alleviating heat-related conditions. Pharmacological studies have demonstrated that these herbs can enhance immune function and improve neurological function. They are often used alone or in conjunction with other pharmacological agents to manage diabetes mellitus (DM) and its coronary heart disease (CHD), cerebral infarction (CI), diabetic nephropathy (DN), diabetic peripheral neuropathy (DPN), and arteriosclerosis obliterans (ASO). This paper systematically summarizes the composition, pharmacological effects, and clinical applications of TJC in recent years. The aim is to provide support and assistance for the further research and development of this compound.

KEYWORDS
clinical applications; drug combinations; ingredients; pharmacological effects; Tongmai Jiangtang Capsule

1 Introduction

Tongmai Jiangtang Capsule (TJC) is a traditional Chinese medicine (TCM) preparation that consists of eleven distinct Chinese herbs. The sovereign drugs in this formulation are *Astragali radix* and *Scrophularia ningpoensis*, while the minister drugs include *Pseudostellariae radix*, *Puerariae lobatae radix*, *Coptis chinensis*, *Atractylodes lancea*, and *Whitmania pigra*. The assistant drugs are *Gynostemma pentaphyllum*, *Dioscoreae rhizoma*, and *Salvia miltiorrhiza*, with *Malvae fructus* serving as the envoy drug. This capsule is primarily utilized in the treatment of diabetes mellitus (DM) that arises from a deficiency of both Qi and Yin, as well as the obstruction of veins and collaterals [1]. Additionally, it is employed in the treatment of diabetic neuropathy and its associated vascular complications. In recent years, there has been a notable rise in the incidence of diabetes across numerous nations. According to data, in 2021, the global prevalence of DM among adults aged 20 to 79 was approximately 537 million, predominantly attributed to type 2 diabetes mellitus (T2DM). Projections indicate that by 2045, the prevalence of DM is expected to escalate by 46%, resulting in an estimated population of 783 million individuals affected by the condition. Therefore, the necessity for the implementation of DM interventions has become increasingly urgent [2]. In the Wanfang database and the China National Knowledge Infrastructure (CNKI), relevant literature was searched using "Tongmai Jiangtang Capsule" as the keyword, and in PubMed and Web of Science, the same keyword was used (Table 1). It was found that there are currently few pharmacological experiments and content determination studies on TJC, with limited clinical application reports available. Consequently, this article aims to review the components, pharmacological effects, and clinical applications of TJC, thereby providing valuable evidence to enhance its application in clinical practice in the future.

Table 1 The Proportion of Various Literatures among 49 Selected Literatures

Type	Number	Content	Proportion
Composition determination	3	Principal active ingredients and their respective contents	6.12%
Pharmacological effect	2	Enhance immune function and improve the nervous system	4.08%
Clinical application	27	DM, CHD, CI, DN, DPN, ASO, MVD	55.10%
Drug combination	17	MET, ALA and mecobalamin, vitamin B1 and B12, dulaglutide, sitagliptin, dapagliflozin, liraglutide, glibenclamide, exenatide, gliquidone	34.69%

ALA: α-lipoic acid; ASO: arteriosclerosis obliterans; CHD: coronary heart disease; CI: cerebral infarction; DM: diabetes mellitus; DN: diabetic nephropathy; DPN: diabetic peripheral neuropathy; MET: metformin; MVD: macrovascular disease.

2 Herbal Medicines in the Formulation of the Preparation and Chemical Composition

2.1 Herbal Medicines in a Prescription and Their Pharmacological Activities

2.1.1 Sovereign Drugs

Astragali radix has demonstrated efficacy in the treatment of cardiovascular diseases (CVD) such as acute myocardial infarction, cerebral thrombosis, and dilated cardiomyopathy [3]. Additionally, it exhibits immune-regulating, lipid-lowering, blood sugar-lowering, anti-tumor, anti-aging, and anti-ulcer effects. In terms of blood glucose reduction, Astragalus has been shown to enhance insulin resistance (IR) and improve glucose tolerance, thereby facilitating its hypoglycemic and DM treatment effects through various biological pathways [4]. In addition, it exhibits therapeutic effects on various complications of DM, such as diabetic nephropathy (DN) and diabetic cardiomyopathy [5].

Scrophularia ningpoensis has anti-inflammatory, anti-oxidant, hepatoprotective, hypoglycemic, and cardioprotective properties. Its ability to lower blood glucose levels (BGL) is primarily attributed to its enhancement of glucose and lipid metabolism, stimulation of insulin secretion, and improvement of oxidative capacity in individuals with T2DM. Additionally, this plant demonstrates therapeutic potential in the management of conditions such as spontaneous hypertension, heart failure, cerebral ischemic injury, and myocardial apoptosis associated with CVD [6].

2.1.2 Minister Drugs

Pseudostellariae radix has been shown to enhance immune function, protect cardiac muscle, exhibit anti-oxidant properties, and promote skin whitening [7]. In addition, it plays a significant role in reducing blood glucose and lipid levels. The polysaccharides contained in it are the main components of its effect. *Pseudostellariae radix* can stimulate the body to secrete insulin, improve the uptake and utilization by muscle and adipose tissues, and improve insulin sensitivity (IS) in the body [8].

Puerariae lobatae radix has pharmacological effects such as treating osteoporosis, relieving alcohol intoxication and protecting the liver, protecting the nervous system, treating diabetes, and improving cardiovascular and cerebrovascular functions. Its role in lowering BGL is primarily attributed to the regulation of insulin-induced preadipocyte differentiation and associated gene expression. Furthermore, in the context of cardiovascular and cerebrovascular diseases, *Puerariae lobatae radix* contributes to myocardial protection, reduction of blood lipid levels, and anti-atherosclerotic effects [9].

Coptis chinensis can treat CVD such as arrhythmia, hypertension, heart failure, and atherosclerosis (AS) [10]. In addition, it exhibits several pharmacological effects, such as reducing blood glucose, anti-tumor, anti-inflammatory and anti-bacterial [11]. Its role in lowering blood glucose is mainly achieved by improving IS, mitigating glucolipotoxicity, and protecting pancreatic islet cells [12].

Atractylodes lancea has the functions of regulating body immunity, treating gastrointestinal diseases, anti-bacterial, anti-inflammatory, and anti-tumor effects [13].

Whitmania pigra facilitates anti-coagulation, contributes to arthritis treatment, exhibits anti-tumor effects, and regulates metabolism. It is instrumental in anti-coagulation processes, simultaneously reducing blood lipid levels, and it demonstrates a notable therapeutic effect on AS [14].

2.1.3 Assistant Drugs

Gynostemma pentaphyllum has anti-oxidant, anti-aging, hepatoprotective, anti-tumor, neuroprotective effects, as well as the ability to regulate blood glucose and blood lipid levels. The active components, saponins and polysaccharides, found in *Gynostemma pentaphyllum* have been shown to significantly reduce the body's IR index and ameliorate complications associated with DM [15].

Dioscoreae rhizoma possesses the ability to regulate immune function, exhibit anti-oxidant properties, contribute to anti-aging effects, demonstrate anti-tumor activity, and assist in the regulation of spleen and stomach functions, as well as in lowering blood sugar and lipid levels. Specifically, with regard to blood glucose reduction, *Dioscoreae rhizoma* has demonstrated potential in the treatment of DN, contributing to weight reduction and the enhancement of renal function [16].

Salvia miltiorrhiza has been demonstrated to possess anti-inflammatory properties, exhibit anti-oxidant effects, and reduce the progression of AS. Additionally, it has shown effectiveness in the treatment of DN by influencing glucose and lipid metabolism, optimizing blood flow distribution, alleviating oxidative stress, and inhibiting inflammatory responses through various mechanisms [17]. The significance of *Salvia miltiorrhiza* in the realm of CVD is notable, with therapeutic applications that include the protection of vascular and myocardial cells, relief of myocardial ischemia, and reduction of ventricular hypertrophy. Its mechanisms of action involve the regulation of calcium channels, improvement of microcirculation, protection of endothelial and smooth muscle cells, and prevention of thrombosis, among other

pathways [18].

2.1.4 Envoy Drug

Malvae fructus exerts diuretic, anti-bacterial, anti-oxidant, and immune-regulating effects [19].

2.2 Characteristic Components and Content Determination

TJC is predominantly utilized in the treatment of DM. However, the specific components that contribute to its therapeutic efficacy remain inadequately defined, and there is a paucity of information regarding this matter in the existing literature. Shen Xiuxiu [20] *et al.* used network pharmacology and molecular docking techniques to screen the primary active ingredients responsible for the hypoglycemic effects of TJC . They selected chemical components from the component-target network that exhibited a degree value of 10 or higher. The selected components included quercetin, β -sitosterol, eugenol, campesterol, isofucosterol, stigmasterol, kaempferol, luteolin, isorhamnetin, and hederagenin. Subsequently, core proteins were selected from the protein interaction network. The affinity between the identified components and their respective targets was assessed using molecular docking techniques, focusing on docking modes that demonstrated strong affinity. The findings indicated that the active ingredients in TJC exert therapeutic effects on DM and its associated complications through a synergistic action involving multiple components, targets, and pathways, specifically engaging nine targets: SRC, ESR1, STAT3, PTPN11, HSP90AA1, EGFR, PIK3R1, AR, and AKT1.

The single indicator components of TCM formulations cannot evaluate the efficacy of these drugs. Besides, there is a notable deficiency in quantitative research regarding the constituents of herbs such as *Astragali radix* and *Scrophularia ningpoensis*, and others in the literature search [21]. Studying the concentration of each component in TJC is beneficial for improving the quality standards of this medication and offers a feasible basis for its clinical application. Yang Bin [21] *et al.* selected seven representative chemical components from TJC based on the principles of confirming quality markers for TCM. These components are calycosin-7-O-glucoside, ononin, formononetin, heterophyllin B, gypenoside XLIX, gypenoside A, and gypenoside XVII. The concentrations of these components were assessed utilizing high-performance liquid chromatography (HPLC) with gradient elution. The findings revealed that gypenoside A and gypenoside XVII were present in higher concentrations, whereas heterophyllin B was found to have a lower concentration. This method has high repeatability, is easy to operate, and serves as the foundation for the quality evaluation of TJC. Wu Yujia [22] *et al.* used high-performance liquid chromatography coupled with Q-Exactive high-resolution mass spectrometry (HPLC-Q-Exactive) to analyze the compounds present in TJC. Through a fingerprinting approach, they successfully identified eight distinct compounds, namely protocatechuic acid, protocatechu aldehyde, puerarin, 3'-methoxy puerarin, puerarin-apiin, daidzin, salvianolic acid B, and tanshinone II A. Subsequently, the concentrations of these eight components were quantified using HPLC. The results indicated that puerarin and salvianolic acid B exhibited high and stable levels, whereas protocatechuic acid demonstrated low and unstable concentrations. Overall, the chromatographic peaks and separation were found to be satisfactory. The methodologies established by the research institute for component identification, fingerprinting, and quantitative analysis can serve as a reference for the multi-index quality assessment and control of TJC.

3 Pharmacological Effects

TJC has been shown to regulate blood glucose, improve vascular function, enhance immune function, regulate blood lipids, resist oxidative stress, and improve nerve function in the process of clinical application. However, only two animal and cell experiments related to TJC were found in the previous literature, and the publication time was early while the research content was limited.

3.1 Enhance Immune Function

Zhang Bin [23] *et al.* demonstrated that the incidence of apoptosis in Schwann cells, which is induced by advanced glycation end-products, significantly diminished following treatment with TJC. The apoptosis of Schwann cells is implicated in the initiation and progression of DN, and within the peripheral nervous system, these cells display properties characteristic of immune-active cells. Mechanistically, the administration of TJC appears to mitigate the inflammatory response and bolster immune function by down-regulating the expression of tumor necrosis factorα (TNF-α) and interleukin-6 (IL-6) in Schwann cells, thereby postponing their apoptotic process.

3.2 Improve the Nerves

Yang Wenqiang [24] *et al.* undertook a study examining the effects of TJC on DPN utilizing a rat model. The findings

revealed a significant increase in nerve conduction velocity and improvements in gait parameters among the subjects that received treatment. Immunohistochemical staining indicated enhancements in both the quantity and morphology of epidermal nerve fibers. Additionally, hematoxylin and eosin staining illustrated a partial restoration of pathological damage to peripheral nerves. These results suggest that TJC has a positive impact on the enhancement of nerve function and the structural integrity of nerve tissue.

4 Clinical Applications

After searching relevant data, it was found that there were a large number of literature reports on the clinical application of TJC, but most of them were reports on the complications of DM, and there were few mentions of CVD. After sorting and comparing the pharmacological effects and clinical applications of TJC (Figure 1), it was found that the treatment of DPN was mentioned in both parts, and some therapeutic mechanisms of other clinical applications were also related to enhancing immune function.

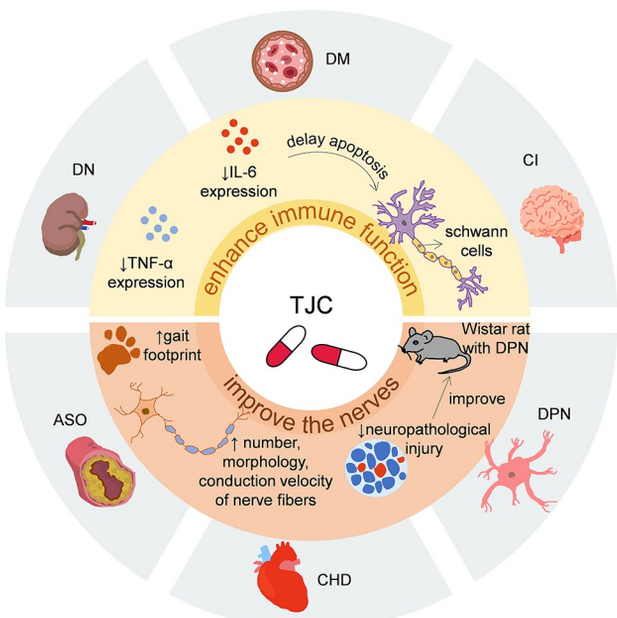

Figure 1 Pharmacological Effects and Clinical Applications of TJC

ASO: arteriosclerosis obliterans; CHD: coronary heart disease; CI: cerebral infarction; DM: diabetes mellitus; DN: diabetic nephropathy; DPN: diabetic peripheral neuropathy; IL-6: interleukin-6; TJC: Tongmai Jiangtang Capsule; TNF-α: tumor necrosis factor α.

4.1 Diabetes Mellitus

TJC is extensively utilized for the purpose of reducing BGL and exhibits distinctive therapeutic effects in the management of DM. Wang Jie [25] *et al.* carried out a study involving 75 patients diagnosed with DM, wherein the observation group was administered TJC as a therapeutic intervention. The findings revealed that, subsequent to the treatment, there was a notable reduction in fasting BGL, along with a significant improvement in the clinical symptoms associated with the three excesses of diabetes. Li Jianmin [26] *et al.* launched a study examining the glucagon levels of patients based on the blood sugar control achieved through the administration of TJC. Glucagon is known to significantly enhance glycogenolysis and stimulate gluconeogenesis, which consequently elevates BGL. The findings revealed that among the 42 patients in the treatment group, both glucagon levels and BGL exhibited a decrease, thereby suggesting the potential efficacy of the drug in the management of DM. Tian Ping [27] undertook a research investigation into the effectiveness of TJC in combination with the Western pharmaceutical glibenclamide tablets for the treatment of T2DM. The results demonstrated that this integrative therapeutic strategy markedly improved patients' insulin secretion index and the homeostasis model assessment of IR index in comparison to the use of glibenclamide tablets alone. Additionally, the combined treatment was successful in alleviating severe symptoms experienced by individuals with DM.

4.2 Coronary Heart Disease

The DM environment within the body can contribute to the development of CHD through various mechanisms and

pathways. These include alterations in glucose and lipid metabolism, as well as an increase in inflammatory cytokines [28]. Wang Yu [29] *et al.* ran a randomized, double-blind, multi-center clinical trial to assess the efficacy of TJC in the treatment of T2DM-CHD. The results demonstrated that these Capsule significantly improved patients' cardiac function and exercise tolerance. The proposed mechanism underlying these effects may be linked to the chemical components found in TJC, specifically formononetin and isotheophylline. Research indicates that formononetin significantly decreases the expression of inflammatory cytokines, including interleukin and TNF. In addition, isotheophylline has been shown to inhibit lipopolysaccharide - induced inflammatory responses and cell apoptosis through the activation of the phosphoinositide 3-kinase/protein kinase B signaling pathway.

4.3 Cerebral Infarction

DM can result in CI, which is characterized by symptoms including speech difficulties and hemiplegia. The incidence of CI is notably elevated among the complications associated with DM [30]. An Xianyong [31] *et al.* performed a study examining the effects of TJC on patients experiencing CI related to T2DM-CI during their recovery phase. The findings indicated that, following treatment, there was a notable improvement in symptoms such as dyspnea, fatigue, chest tightness, headache, and palpitations. Moreover, significant enhancements were observed in BGL, lipid profiles, and inflammatory markers. In addition, TJC combined with conventional drugs can improve the glucose and lipid metabolism and neurological deficits in patients.

4.4 Diabetic Nephropathy

DN is a microvascular complication associated with DM, characterized by a decline in kidney function and an increased risk of CVD and mortality among affected patients [32]. Dong Yong [33] demonstrated that TJC is effective in reducing levels of glycosylated hemoglobin (HbA1c), 24-hour urinary microalbumin, and serum cystatin C, while also improving the glomerular filtration rate. These findings suggest that TJC has a beneficial therapeutic effect on DN. Liu Yi [32] *et al.* investigated the potential mechanisms underlying the therapeutic effects of TJC in the treatment of DN. Their study employed a comprehensive approach that included database searches, molecular docking technology, and Mendelian randomization. The findings indicated that the Capsule's therapeutic efficacy is primarily mediated through pathways associated with immune regulation and the modulation of inflammatory responses. Kong Demei [34] conducted a comparative analysis of the indices of patients with DN before and after the administration of TJC. The study revealed a reduction in both blood lipid levels and blood viscosity among patients following the treatment. This enhancement may be ascribed to the pharmacological properties of *Salvia miltiorrhiza*, which encompass peripheral blood vessel dilation, anti-coagulation, and the modulation of microcirculation.

4.5 Diabetic Peripheral Neuropathy

DPN is the most common type of chronic complication linked to DM. Individuals affected by this condition frequently describe sensations of numbness and tingling, which can considerably impair their daily activities [35]. Sun Linxi [36] *et al.* performed a systematic review and meta-analysis of the current literature, demonstrating that the administration of TJC alongside conventional treatment significantly improves the conduction velocity of the median nerve. These results indicate that this formulation may provide a beneficial therapeutic effect in the treatment of DPN. Chen Yuyu [37] *et al.* conducted controlled experiments that revealed the administration of TJC alongside mecobalamin tablets leads to a significant reduction in patients' HbA1c levels and Toronto clinical scores. These scores are utilized as a metric for evaluating the efficacy of the treatment, which is based on patients' symptoms and clinical indicators. Zhang Aiqi [38] *et al.* undertook a study involving 106 patients diagnosed with DPN. The control group was subjected to a regimen that included exercise, dietary therapy, Western medicine, and Methycobal tablets, while the treatment group received TJC in conjunction with these interventions. Subsequent evaluations following the treatment indicated that patients in the treatment group demonstrated a statistically significant improvement in nerve conduction velocity, as assessed by electromyography, alongside a marked enhancement in clinical symptoms based on TCM.

4.6 Arteriosclerosis Obliterans

ASO is a clinical manifestation of systemic atherosclerosis that primarily affects the lower extremities [39-40]. Zhou Xiaode [41] *et al.* carried out a study to assess the pre- and post-treatment effects of TJC in a sample of 139 patients diagnosed with DM complicated by ASO. The results indicated that 97.12% of the participants experienced either complete resolution or a significant reduction in major clinical symptoms, accompanied by marked healing or improvement of their wounds. Furthermore, improvements in collateral circulation and overall blood flow were noted among the patients. These

findings suggest that TJC may have a beneficial therapeutic effect in alleviating limb symptoms and could be instrumental in preventing disease progression and the onset of gangrene.

5 Combined with Other Drugs

5.1 Combined with Metformin

Metformin (MET) is a commonly employed drug in the clinical management of T2DM. Its mechanism of action involves the reduction of glucose absorption in the small intestine, which leads to a decrease in postprandial hyperglycemia. Moreover, MET is known to improve IS [42]. MET is widely recognized as the primary pharmacological intervention for T2DM; however, extended usage may lead to dependence, an escalation in adverse effects, and a reduction in therapeutic effectiveness [43]. Bai Hongchao [44] found that the concurrent use of TJC and MET may enhance clinical outcomes, as demonstrated by a significant improvement in BGL, a reduction in symptoms associated with TCM syndromes, and an overall enhancement in quality of life. In the management of DN, research conducted by Li Jiling [45] *et al.* suggests that the concurrent use of TJC and MET leads to a significant reduction in BGL, as well as an improvement in renal function. Additionally, this therapeutic combination exhibits a positive safety profile. Yilimire Nurmamat [1] *et al.* initiated a study to examine the effects of TJC in conjunction with the Western medication MET for the management of T2DM. The control group took MET tablets, and the treatment group took TJC on the basis of MET tablets. The immunological indices in the experimental results were compared. It was observed that following treatment, the levels of T lymphocytes and the ratio of T lymphocytes to cytotoxic T cells in the treatment group were significantly elevated compared to both the control group and the pre-treatment measurements. At the same time, the levels of C-reactive protein and tumor necrosis factor were significantly lower than those observed in the control group and prior to treatment. This finding suggests that TJC may enhance the body's immune function and mitigate the inflammatory response in conjunction with MET treatment. This study offers novel insights for the clinical application of TJC.

5.2 Combined with α-Lipoic Acid and Mecobalamin

Both α-lipoic acid (ALA) and mecobalamin are utilized in the management of DPN. Mecobalamin can nourish nerve tissue and improve the symptoms of the disease to a certain extent, but it has more adverse reactions and poor effect when used alone, and it should be used in conjunction with ALA to enhance therapeutic outcomes. ALA has been demonstrated to reduce nerve damage caused by oxidative stress and exhibits a favorable therapeutic profile [46]. Mo Guiguo [47] found that the synergistic use of TJC in conjunction with ALA and mecobalamin can substantially mitigate the symptoms associated with DPN. Additionally, this combination significantly improves the conduction velocity of neuropathic tissues, thereby providing a basis for its potential clinical application.

5.3 Combined with Vitamin B1 and B12

Research indicates that B vitamins contribute positively to nerve function, with vitamin B1 aiding in the transmission of excitatory signals within nerve cells and vitamin B12 being essential for the repair of injured neurons and the support of neuronal regeneration. These vitamins are frequently employed in the treatment of DPN; nevertheless, their effectiveness is frequently constrained when used as isolated therapeutic agents [48]. Hao Guimin [49] undertook a study to evaluate the effectiveness of TJC in combination with vitamins B1 and B12 for the management of DPN in a cohort of 30 patients. The results indicated that participants either achieved complete symptom resolution or experienced a substantial alleviation of subjective symptoms. Moreover, significant enhancements in superficial sensation and tendon reflexes were documented. The study concluded that the combination of TJC with vitamins B1 and B12 is effective and possesses a favorable safety profile.

5.4 Combined with Dulaglutide

Dulaglutide is an innovative glucagon-like peptide-1 (GLP-1) receptor agonist distinguished by its extended half-life, which facilitates effective management through once-weekly dosing. The administration of this pharmacological agent is relatively uncomplicated, making it an appropriate option for the treatment of obesity in individuals with T2DM. Nevertheless, as the disease progresses, patients frequently encounter a gradual elevation in BGL. As a result, reliance on dulaglutide alone for clinical management becomes increasingly problematic. Therefore, it is essential to investigate more effective combination therapies for the treatment of this condition [50-51]. Liu Yuan [51] undertook a research study utilizing clinical data from 87 patients diagnosed with obesity-related T2DM, dividing them into a control group and a treatment group. The control group included 43 patients who were treated with dulaglutide, while the treatment group comprised

44 patients who received TJC in addition to dulaglutide. The results of the study suggested that the combination of these two therapeutic agents may enhance clinical efficacy, lower blood glucose-related parameters, alleviate symptoms associated with TCM, and improve blood rheology and microcirculation, all without an increase in adverse effects.

5.5 Combined with Sitagliptin

Sitagliptin has demonstrated the ability to promote insulin production, inhibit the secretion of glucagon, and support the repair and regeneration of islet β - cells, while also preventing their apoptosis. Collectively, these mechanisms play a significant role in the regulation of glucose homeostasis in the body [52]. Yan Xudong [53] initiated a study involving 96 patients diagnosed with T2DM. The control group received sitagliptin, and the experimental group was administered TJC in conjunction with sitagliptin. The findings indicated that the combination therapy effectively regulated the BGL of the patients and enhanced the overall treatment outcomes, thereby contributing valuable insights for the clinical management of T2DM.

5.6 Combined with Dapagliflozin

Dapagliflozin is a novel drug that enhances urinary glucose excretion mainly by inhibiting sodium-glucose cotransporters. It lowers blood glucose without dependence on insulin, resulting in effective glycemic control [54]. Xie Lifen [55] *et al.* investigated the efficacy of TJC in conjunction with dapagliflozin for the treatment of T2DM and its impact on pancreatic function. The results revealed that this combination therapy significantly regulates blood glucose and lipid levels, improves IR, and enhances both cardiac function and islet β - cells' function, all while exhibiting a favorable safety profile.

5.7 Combined with Liraglutide

Liraglutide is a synthetic analog of GLP-1 that effectively emulates the physiological actions of insulin, leading to a reduction in BGL via multiple mechanisms. Additionally, it exhibits anti-inflammatory and anti-oxidant properties, as well as protective effects on renal and cardiovascular systems [56]. Zhang Yanli [57] *et al.* explored how effective the combination of TJC and liraglutide was in treating T2DM. The results demonstrated that this combined therapeutic approach led to significant improvements in TCM syndromes, a reduction in IR, and effective regulation of BGL.

6 Summary and Prospect

In clinical practice, TJC, a TCM preparation, is primarily used for treating T2DM and the associated complications. TJC's active components act through multiple targets, multiple channels and mechanisms. At present, many studies have been performed on the clinical application of TJC, mainly focusing on its hypoglycemic effects. This article aims to summarize the research progress of TJC and to suggest that certain aspects warrant further attention in the comprehensive investigation of this formulation. First, the literature retrieval mainly focused on the clinical application of TJC in lowering blood glucose, and there were few pharmacological experiments to study the mechanism of TJC. Further research is needed. Second, there is a significant gap in efficacy studies that assess the specific pharmacological effects of the various combinations of TCM incorporated in these capsules. It is crucial to investigate the relationship between pharmacological effects and TCM compatibility. Besides, with respect to the chemical composition and content analysis of TJC, only a limited number of characteristic components have been quantified. Certain trace components within the formulation may exert significant effects but are difficult to detect. Thus, the development and implementation of innovative measurement techniques are essential for future research endeavors. Additionally, there is a general paucity of efficacy studies related to the treatment of CVD in the existing literature. Therefore, it is imperative that future research on TJC adopts a holistic approach that encompasses the examination of compound components, mechanisms of action, and pharmacological effects. This approach should aim to broaden the clinical applicability and systematically enhance the medicinal value of TJC.

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