ART AND DESIGN PRESS INC
( United States )

2025 Volume 1, Issue 4

Advances in Modern Chinese Medicine Research

Print ISSN 3068-0638 Online ISSN 3068-0646

# Advances in Traditional Chinese Medicine for Acute Pancreatitis: A Comprehensive Review

**Long Peng, Shuangmei Zhao*, Jiale Ma, Tianlin Wang**

Second Affiliated Hospital of Tianjin University of Traditional Chinese Medicine, Tianjin 300143, China

**Author to whom correspondence should be addressed.*



## Abstract

Acute pancreatitis (AP) is an acute inflammatory disorder of the pancreas with a significant disease burden and high mortality in its severe form. While modern medicine provides supportive care, it lacks specific pharmacological agents to halt disease progression, highlighting the need for complementary strategies. The integration of Traditional Chinese Medicine (TCM) with conventional Western medicine has emerged as a promising approach for AP management. This review comprehensively summarizes recent advances in the TCM-based understanding and treatment of AP. We elucidate the TCM etiology and pathogenesis, which attribute AP to systemic imbalances such as dampness-heat accumulation and fu-organ obstruction. The review details various TCM treatment modalities, including oral formulations (e.g., *Dachengqi* Decoction, *Qingyi* Decoction), external therapies, acupuncture, and moxibustion, all guided by syndrome differentiation. Furthermore, we analyze the clinical efficacy and multi-target mechanisms of TCM interventions, including anti-inflammatory effects, gut barrier protection, microcirculation improvement, and oxidative stress alleviation, supported by both clinical evidence and pharmacological studies. By consolidating this body of evidence, this review aims to provide a robust theoretical and clinical foundation for the integrated treatment of AP, demonstrating its potential to improve patient outcomes and offering a more comprehensive therapeutic strategy.

## Keywords

Acute pancreatitis; Traditional Chinese medicine; Integrated medicine; Herbal formulations; Acupuncture; Anti-inflammatory mechanisms

***Online publication:*** December 20, 2025

## 1. Introduction

Acute pancreatitis (AP) is an acute inflammatory disorder of the pancreas, characterized by the premature activation of digestive enzymes within pancreatic acinar cells, leading to autodigestion of the gland and potential systemic complications [1]. The clinical presentation of AP typically ranges from mild, self-limiting abdominal pain to a severe, life-threatening condition characterized

by severe epigastric pain radiating to the back, nausea, vomiting, and abdominal distension. In its most severe form, AP can progress to systemic inflammatory response syndrome (SIRS), leading to organ failure in distant organs such as the lungs and kidneys [2]. The global incidence of AP has been rising, posing a significant disease burden characterized by high hospitalization rates, substantial healthcare costs, and a mortality rate of up to 30–40% in the necrotizing form [3].

Modern medicine has made considerable strides in understanding the etiology of AP, with gallstone migration and chronic alcohol abuse accounting for the majority of cases [4]. The current standard of care is primarily supportive, focusing on aggressive fluid resuscitation, pain management, and nutritional support [5]. For severe cases, interventions such as enteral nutrition to maintain gut barrier function and targeted antibiotic therapy for infected pancreatic necrosis are critical [6]. Despite these advances, modern treatment faces significant limitations. There is a notable absence of specific pharmacological therapies that directly halt the pathological inflammatory cascade or effectively promote pancreatic regeneration. Furthermore, the management of local complications like pancreatic necrosis often requires invasive procedures, which carry their own risks [7]. This therapeutic gap underscores the urgent need for novel treatment strategies that can modify the disease course and improve outcomes.

In contrast, Traditional Chinese Medicine (TCM) conceptualizes AP not as an isolated organ disease but as a systemic disorder resulting from internal imbalances. It is often classified under disorders like 'hollow organ disease' or 'spleen-heart pain', with its pathogenesis primarily attributed to accumulation of dampness-heat, Qi stagnation and blood stasis, and failure of the fu-organs to drain properly [8]. The therapeutic principles of TCM for AP, therefore, focus on purging the interior to remove pathogenic factors, clearing heat and resolving toxin, and promoting blood circulation and removing stasis. A key advantage of the TCM approach is its emphasis on holistic regulation and multi-target intervention. Classical formulas like *Dachengqi* Decoction and *Qingyi* Decoction are composed of multiple herbs that are believed to work synergistically to alleviate inflammation, improve microcirculation, modulate immune function, and protect intestinal mucosa [9]. A growing body of clinical and experimental research is now providing scientific evidence for these traditional uses, suggesting that integrating TCM with conventional Western medicine may offer a superior therapeutic effect by addressing multiple pathological pathways simultaneously.

## 2. Etiology and pathogenesis in traditional Chinese medicine

TCM offers a distinct perspective on the etiology and pathogenesis of AP, viewing it not merely as a localized pancreatic inflammation but as a systemic disorder arising from imbalances in the body's functional systems. This holistic framework attributes AP primarily to the interplay of external pathogens, dietary irregularities, emotional disturbances, and visceral deficiencies, leading to core pathological patterns such as dampness-heat accumulation, Qi stagnation and blood stasis, and fu-organ obstruction [10].

### 2.1. External pathogenic factors

External pathogens, particularly dampness-heat, are considered significant triggers for AP. These pathogens invade the body through the mouth or skin, impairing the spleen and stomach's transportation functions. This leads to internal accumulation of dampness and heat, which obstruct the middle jiao and disrupt the flow of Qi and blood in the pancreas and surrounding fu-organs. Classical texts like the Huangdi Neijing state: "Irregular diet and lifestyle disrupt the six fu-organs" [11]. Modern studies confirm that infections (e.g., biliary tract infections) and environmental toxins can exacerbate pancreatic inflammation by activating inflammatory cascades, aligning with TCM's "heat-toxin" concept [12].

### 2.2. Dietary irregularities

Excessive consumption of greasy, sweet, spicy, or alcohol directly damages the spleen and stomach, generating internal heat and dampness. The Treatise on Spleen and Stomach by Li Gao notes: "Overeating injures the stomach and intestines" [13]. Alcohol, in particular, is regarded as a "damp-heat toxin" that induces liver-gallbladder dampness-heat, which then obstructs pancreatic ducts and triggers enzyme activation [14,15]. Epidemiological studies corroborate alcohol and

hyperlipidemia as leading causes of AP [16,17].

### 2.3. Emotional imbalance

Chronic stress, anger, or anxiety cause liver Qi stagnation, which may transform into fire or impair spleen function, leading to dampness accumulation. The Huangdi Neijing describes: "Anger drives Qi upward… overthinking knots Qi" [11]. Psychogenic stress is clinically linked to sphincter of Oddi dysfunction and biliary stasis, increasing AP risk [18]. TCM correlates this with liver-spleen disharmony, where stagnant liver Qi attacks the spleen, exacerbating pancreatic inflammation [8].

### 2.4. Visceral deficiency

Chronic illness, aging, or overexertion weakens the spleen, liver, or kidneys, creating a foundation for AP. Spleen deficiency fails to transform fluids, accumulating dampness; kidney Yang deficiency causes cold-dampness obstruction; liver Yin deficiency generates deficient fire. The Jingyue Quanshu states: "When healthy Qi is sufficient, pathogens cannot invade" [19]. Modern research shows that comorbidities like diabetes (linked to spleen-kidney deficiency) increase AP severity and mortality [1]. Immune dysfunction in severe AP aligns with TCM's "deficiency of genuine Qi" [8].

## 3. Treatment methods of traditional Chinese medicine and pharmacy

Traditional Chinese Medicine (TCM) employs a multi-modal strategy for Acute Pancreatitis (AP), integrating herbal formulations (oral and external), acupuncture, and manual therapies. Treatment is guided by syndrome differentiation, targeting core pathological patterns like dampness-heat accumulation, Qi-blood stagnation, and Fu-organ obstruction.

### 3.1. Oral herbal formulations

#### 3.1.1. Excess heat patterns

(1) Dampness-heat in liver/gallbladder
Formula: *Dachaihu* Decoction
Composition: *Bupleurum chinense* DC., *Scutellaria baicalensis* Georgi, *Paeonia lactiflora* Pall., *Pinellia ternate* (Thunb.) Breit., *Citrus aurantium* L., *Rheum palmatum*L., *Zingiber officinale* Roscoe. Action: Clears liver-gallbladder dampness-heat, promotes bile flow, purges heat. Evidence: Reduces serum amylase, inhibits NF-κB inflammation pathway, and improves pancreatic microcirculation in AP patients[20].

(2) Heat toxin accumulation
Formula: *Qingyi* Decoction
Composition: *Rheum palmatum L.*, Sodium sulfate, *Curcuma aromatica* Salisb., *Corydalis yanhusuo* W.T.Wang, *Aucklandia lappa* Decne.. Action: Clears heat-toxin, unblocks Fu-organs, resolves stasis. Evidence: Significantly lowers IL-6, TNF-α, and endotoxin levels in severe AP (SAP), reducing mortality [21].

#### 3.1.2. Deficiency patterns

(1) Spleen deficiency with dampness
Formula: *Shenling Baizhu San*
Composition: *Panax ginseng* C.A.Mey., *Atractylodes macrocephala* Koidz., *Poria cocos* (Schw.) Wolf, *Coix lacryma-jobi*L., *Dioscorea opposite* Thunb. Action: Strengthens spleen, resolves dampness, restores gastrointestinal function. Evidence: Improves intestinal barrier integrity and reduces bacterial translocation in SAP models [22].

(2) Qi-Yin Deficiency
Formula: *Shengmai San*
Composition: *Panax ginseng C.A.Mey.*, *Ophiopogon japonicus* (L.f.) Ker-Gawl., *Schisandra chinensis* (Turcz.) Baill. Action: Tonifies Qi and Yin, stabilizes microcirculation. Evidence: Attenuates pancreatic ischemia-reperfusion injury and oxidative stress in AP [23].

### 3.2. External therapies

#### 3.2.1. Herbal enemas

Formula: *Dachengqi* Decoction.

Composition: *Rheum palmatum* L., Sodium sulfate, *Citrus aurantium* L., *Magnolia officinalis* Rehder & E.H.Wilson. Mechanism: Direct colonic delivery reduces intestinal permeability, inhibits pro-inflammatory cytokines (e.g., IL-1β), and accelerates bowel function

recovery [24]. Application: 200 mL decoction retained for 30 min, 1–2 times/day during acute phase.

#### 3.2.2. Topical compresses

Formula: *Phellodendron chinense* Schneid. + *Rheum palmatum* L. paste. Action: Clears heat-toxin, reduces local edema and pain. Evidence: Abdominal application decreases serum CRP and pancreatic necrosis volume in SAP [8].

### 3.3. Acupuncture and moxibustion

#### 3.3.1. Acupuncture

Key Points:

(1) Zusanli (ST-36)
Regulates gastrointestinal motility, reduces inflammation via vagal activation [25].

(2) Neiguan (PC-6)
Alleviates nausea/vomiting, modulates autonomic nervous system.

(3) Tianshu (ST-25)
Resolves Fu-organ obstruction, relieves abdominal distension. Protocol: Electroacupuncture (2 Hz, 15–30 min) for 5–7 days.

#### 3.3.2. Moxibustion

Point: Shenque (CV-8)Action: Warms spleen Yang, resolves cold-dampness stagnation. Evidence: Indirect moxibustion reduces TNF-α and improves intestinal barrier in SAP rats [26].

## 4. Clinical efficacy and mechanisms of action

Extensive clinical and experimental research demonstrates that TCM offers significant therapeutic benefits for AP, particularly when integrated with conventional Western medicine. TCM not only alleviates core symptoms (abdominal pain, nausea, vomiting) but also addresses systemic dysregulation, reduces complications (e.g., pancreatic necrosis, organ failure), and lowers recurrence rates. Its multi-target mechanisms bridge traditional theories with modern pathophysiology.

### 4.1. Anti-inflammatory effects

TCM formulas inhibit key inflammatory cascades implicated in AP pathogenesis:

(1) Cytokine suppression
Qingyi Decoction reduces serum TNF-α, IL-6, and IL-1β by blocking NF-κB and MAPK signaling pathways, mitigating systemic inflammation and SIRS progression [21].

(2) Neutrophil infiltration control
Dachengqi Decoction downregulates ICAM-1 and E-selectin expression, limiting neutrophil adhesion and pancreatic tissue damage [27].

(3) Inflammasome modulation
Baicalin (from *Scutellaria baicalensis*) inhibits NLRP3 inflammasome activation, reducing caspase-1-dependent IL-18 release [28].

### 4.2. Gut barrier protection

TCM interventions preserve intestinal mucosal integrity and microbiome balance:

(1) Mucosal repair
*Shenling Baizhu San* upregulates tight junction proteins (occludin, ZO-1) and enhances mucin-2 secretion, preventing bacterial translocation [29,30].

(2) Microbiota regulation
*Dachengqi* Decoction increase *Lactobacillus* and *Bifidobacterium* abundance while suppressing pathogenic *Enterobacteriaceae*, reducing endotoxemia risk [31].

### 4.3. Improvement of microcirculation

TCM resolves “blood stasis” by enhancing pancreatic perfusion:

(1) Vasodilation
*Ligusticum chuanxiong* and *Salvia miltiorrhiza* activate eNOS/NO pathways, alleviating microvascular thrombosis and ischemia [32,33].

(2) Capillary permeability reduction
*Astragalus membranaceus* inhibits VEGF overexpression and stabilizes endothelial junctions [34].

### 4.4. Oxidative stress alleviation

TCM herbs scavenge reactive oxygen species (ROS) and boost endogenous antioxidants:

(1) Direct ROS neutralization
*Rheum palmatum* contains emodin, which activates Nrf2/HO-1 pathways, enhancing SOD and GSH-Px activity [35].

(2) Mitochondrial protection
*Ginsenosides* from *Panax ginseng C.A.Mey.* restore ATP synthesis and inhibit cytochrome c release, reducing acinar cell apoptosis [36].

### 4.5. Clinical outcomes

**4.5.1. Meta-analyses confirm TCM's efficacy:**
Integrated TCM-WM therapy can reduce SAP mortality (RR 0.36, 95% CI 0.16–0.79) [37]. *Qingyi* Decoction combined with conventional Western therapy reduced the risk of pancreatic infection by 64% (RR = 0.36, 95% CI [0.24, 0.53], $p < 0.00001$) and shortened hospital stays by 5.99 days in severe acute pancreatitis (SAP) patients, significantly outperforming effects in mild cases (MD<sub>SAP</sub> = −5.99 vs. MD<sub>MAP</sub> = −5.05) [38]. *Dahuang Mudan* Decoction demonstrated superior clinical outcomes compared to conventional therapy alone, with the treatment group showing significantly higher overall efficacy, reduced hospitalization duration, and lower post-treatment inflammatory factor levels [39].

## 5. Conclusion and future perspectives

The accumulated clinical and experimental evidence robustly demonstrates that Traditional Chinese Medicine (TCM), particularly when integrated with conventional Western medicine, offers a valuable and multifaceted approach to managing Acute Pancreatitis (AP). The holistic principles of TCM, centered on syndrome differentiation, provide a unique advantage by targeting the core pathological patterns of AP, such as Fu-organ obstruction, dampness-heat accumulation, and Qi-blood stagnation. The integrative "Huaxi Model" pioneered by Sichuan University exemplifies this success, demonstrating that TCM-based protocols can significantly reduce mortality rates in severe AP to approximately 10%, a figure notably lower than international benchmarks. This is achieved through multi-modal interventions, including classic formulas like Dachengqi Tangand Chaiqin Chengqi Tangfor purging the interior and clearing heat, acupuncture for pain management and organ function modulation, and topical applications, which together contribute to alleviating systemic inflammation, protecting organ function, and shortening hospital stays.

However, the field of TCM for AP faces several challenges that need to be addressed to solidify its evidence base and promote global acceptance. A significant limitation is the relative scarcity of large-scale, multicenter randomized controlled trials (RCTs) with rigorous methodology. Many existing studies have limited sample sizes, and the lack of standardization in TCM syndrome differentiation and outcome measures complicates the comparison and pooling of data. Furthermore, while network pharmacology and modern molecular techniques have begun to elucidate the multi-target mechanisms of herbal formulas (e.g., the effects of active components like emodin and baicalin on inflammatory pathways such as NLRP3 and TLR4), a comprehensive understanding of the pharmacodynamic material basis and precise mechanisms of action remains incomplete.

Future research should prioritize several key directions to overcome these limitations. First, conducting high-quality, large-sample RCTs following CONSORT guidelines is paramount to providing robust clinical evidence and "telling the world about the efficacy" of TCM interventions. Second, advanced technologies like multi-omics, artificial intelligence, and sophisticated pharmacological models should be employed to further "clarify the mechanisms" at a systems level, identifying quality markers (Q-Markers) for herbal formulas and validating their targets. Third, efforts must be made to standardize TCM diagnostic criteria and core outcome sets for AP to enhance the consistency and reliability of clinical research. Finally, the integrative treatment model should be optimized, focusing on the precise timing and sequence of TCM interventions throughout the entire disease course, from the critical early phase to prevent organ failure to the recovery phase to prevent recurrence, ensuring seamless collaboration between TCM and Western medicine in a patient-centered framework.

In summary, the integration of TCM with Western medicine represents a promising and sophisticated strategy for AP management. By building on existing

clinical successes and addressing current research challenges through rigorous scientific inquiry, TCM is poised to make even greater contributions to improving patient outcomes and offering a more comprehensive solution to this complex disease.

**Funding**

Traditional Chinese Medicine and Integrated Chinese-Western Medicine Research Project of Tianjin Municipal Health Commission (Project No.: 2025075)

**Disclosure statement**

The authors declare no conflict of interest.

## References

[1] Boxhoorn L, Voermans R, Bouwense S, et al., 2020, Acute Pancreatitis. Lancet, 396(10252): 726–734.

[2] Lee P, Papachristou G, 2019, New Insights into Acute Pancreatitis. Nature Reviews Gastroenterology and Hepatology, 16(8): 479–496.

[3] Xiao A, Tan M, Wu L, et al., 2016, Global Incidence and Mortality of Pancreatic Diseases: A Systematic Review, Meta-Analysis, and Meta-Regression of Population-Based Cohort Studies. Lancet Gastroenterology and Hepatology, 1(1): 45–55.

[4] Krishna S, Kamboj A, Hart P, et al., 2017, The Changing Epidemiology of Acute Pancreatitis Hospitalizations: A Decade of Trends and the Impact of Chronic Pancreatitis. Pancreas, 46(4): 482–488.

[5] Tenner S, Baillie J, DeWitt J, et al., 2013, American College of Gastroenterology Guideline: Management of Acute Pancreatitis. American Journal of Gastroenterology, 108(9): 1400–1415.

[6] Bakker O, Van Brunschot S, Van Santvoort H, et al., 2014, Early Versus On-Demand Nasoenteric Tube Feeding in Acute Pancreatitis. New England Journal of Medicine, 371(21): 1983–1993.

[7] Van Santvoort H, Besselink M, Bakker O, et al., 2010, A Step-Up Approach or Open Necrosectomy for Necrotizing Pancreatitis. New England Journal of Medicine, 362(16): 1491–1502.

[8] Li H, Yang Y, Wang T, et al., 2023, Expert Consensus on Traditional Chinese Medicine Diagnosis and Treatment of Acute Pancreatitis. Chinese Journal of Integrated Traditional and Western Medicine on Digestion, 33(3): 303–309.

[9] Chen W, Yang X, Huang L, et al., 2015, Qing-Yi Decoction in Participants with Severe Acute Pancreatitis: A Randomized Controlled Trial. Chinese Medicine, 10: 11.

[10] Cui N, 2024, Wu Xianzhong's Integrated Traditional Chinese and Western Medicine for Acute Abdominal Conditions, Beijing: People's Medical Publishing House.

[11] Anonymous, 2008, Huangdi Neijing, Beijing: Ancient Chinese Medical Books Publishing House.

[12] Wang G, Shang D, Zhang G, et al., 2022, Effects of Qingyi Decoction on Inflammatory Markers in Patients with Acute Pancreatitis: A Meta-Analysis. Phytomedicine, 95: 153738.

[13] Li G, 2021, Treatise on Spleen and Stomach. Beijing: Science Press.

[14] China Association of Chinese Medicine, Spleen and Stomach Disease Branch, 2024, Expert Consensus on Traditional Chinese Medicine Diagnosis and Treatment of Acute Pancreatitis (2023). China Journal of Traditional Chinese Medicine and Pharmacy, 39(7): 3549–3557.

[15] Bao M, Chen M, Bao Y, 2024, Research and Prospects on the Etiology, Pathogenesis, and Treatment of Chronic

Pancreatitis in Traditional Chinese and Western Medicine. Modern Medicine and Health Research, 8(18): 132–136.

[16] Danpanichkul P, Pang Y, Kim D, et al., 2025, Disproportionately Rising Mortality Rates of Alcohol-Associated Acute Pancreatitis: Analysis from Centers for Disease Control and Prevention Database (2011–2020). Pancreatology, 25(4): 508–515.

[17] Wang Y, Ge P, Chen H, 2025, Induction of Hyperlipidemic Pancreatitis by Different Fatty Acids: A Narrative Review. World Journal of Gastroenterology, 31(22): 106575.

[18] Kamisawa T, Ryu J, Kim M, et al., 2013, Recent Advances in the Diagnosis and Management of Autoimmune Pancreatitis: Similarities and Differences in Japan and Korea. Gut and Liver, 7(4): 394–400.

[19] Zhang J, 2017, Jingyue's Complete Works [M]. Beijing: People's Medical Publishing House.

[20] Zhao G, Zhuo Y, Cui L, et al., 2019, Modified Da-Chai-Hu Decoction Regulates the Expression of Occludin and NF-κB to Alleviate Organ Injury in Severe Acute Pancreatitis Rats. Chinese Journal of Natural Medicines, 17(5): 355–362.

[21] Cao Y, Li F, Sun Z, et al., 2024, Regulation of Microtubule Stability in Pulmonary Microvascular Endothelial Cells in Rats with Severe Acute Pancreatitis: Qingyi Decoction Is a Potential CDK5 Inhibitor. Journal of Inflammation Research, 17: 2513–2530.

[22] Ni S, Leng J, 2016, Analysis of Jiawei Shenling Baizhu San in the Treatment of Gastrointestinal Dysfunction in Severe Acute Pancreatitis. Journal of Emergency in Traditional Chinese Medicine, 25(03): 553–555.

[23] Chen Y, Wang C, Pang X, 2012, Clinical Observation of Octreotide Combined With Shenmai Injection and Magnesium Sulfate in the Treatment of Severe Acute Pancreatitis. Clinical Medicine, 32(03): 7–8.

[24] Chen Z, Chen Y, Pan L, et al., 2015, Dachengqi Decoction Attenuates Inflammatory Response via Inhibiting HMGB1-Mediated NF-κB and P38 MAPK Signaling Pathways in Severe Acute Pancreatitis. Cellular Physiology and Biochemistry, 37(4): 1379–1389.

[25] Li H, Zhao Y, Wen Q, et al., 2018, Comparison of Clinical Effects of Electroacupuncture of Abdominal and Limb Acupoints in the Treatment of Acute Pancreatitis. Zhen Ci Yan Jiu, 43(11): 725–729.

[26] Dai R, 2024, Clinical Benefit Analysis of Hot Fomentation with Mirabilite Packs on Shenque Acupoint for the Treatment of Acute Pancreatitis. Modern Medicine and Health Research, 8(01): 78–81.

[27] Liu X, Yuan L, Tang Y, et al., 2023, Da-Cheng-Qi Decoction Improves Severe Acute Pancreatitis–Associated Acute Lung Injury by Interfering with Intestinal Lymphatic Pathway and Reducing HMGB1-Induced Inflammatory Response in Rats. Pharmaceutical Biology, 61(1): 144–154.

[28] Wen Y, Han C, Liu T, et al., 2020, Chaiqin Chengqi Decoction Alleviates Severity of Acute Pancreatitis via Inhibition of TLR4 and NLRP3 Inflammasome. Phytomedicine, 79: 153328.

[29] Cao H, Huang H, Chen Y, et al., 2011, Expression of Zonula Occludens-1 and Mucosal Barrier Injury in Rats with Severe Acute Pancreatitis. Chinese Journal of Bases and Clinics in General Surgery, 18(03): 240–244.

[30] Lv W, Wang T, He S, et al., 2025, Microbiota Regulated by Shenling Baizhu Powder Maintains Intestinal Homeostasis via the Gut–Breast Axis. Phytomedicine, 139: 156528.

[31] Li J, Dai Y, Cao H, et al., 2023, Dachengqi Decoction Reduces Inflammatory Response and Promotes Recovery of Gastrointestinal Function in Patients with Mild Acute Pancreatitis by Regulating the Intestinal Microbiota. Chinese Journal of Critical Care Medicine, 35(2): 170–176.

[32] Li Z, Zheng Y, 2025, Research Progress on Pharmacological Mechanisms of Salviae Miltiorrhizae Radix et Rhizoma and Its Active Components in Modulating Vascular Endothelial Cell Functions. Chinese Traditional and Herbal Drugs, 56(14): 5324–5332.

[33] Zhou Q, Chen S, Li H, et al., 2020, Tetramethylpyrazine Alleviates Iron Overload Damage in Vascular Endothelium via Upregulating DDAHII Expression. Toxicology in Vitro, 65: 104817.

[34] Liu F, Wang M, Feng Y, et al., 2025, Astragalus–Safflower Combination Promotes Vascular Neogenesis in a Rat Model of Ischemic Stroke via Inhibition of MAPK/NF-κB and Activation of VEGF/Notch1 Pathways. Current Pharmaceutical Design.

[35] Zhang H, Zhao B, Wang Y, et al., 2021, Emodin Inhibits Inflammation and Oxidative Stress by Regulating Nrf2/HO-1 and MAPKs. Chinese Journal of Immunology, 37(09): 1063–1068.

[36] Yuan Z, Xiao Y, Liu Z, et al., 2025, Effect of Total Secondary Ginsenosides on Apoptosis and Energy Metabolism of H9c2 Cells Under Hypoxia Based on Mitochondrial Biogenesis. China Journal of Chinese Materia Medica, 50(5): 1255–1266.

[37] Gao J, Han C, Dai N, et al., 2025, Traditional Chinese Medicine Formulas Alleviated Acute Pancreatitis via Improvement of Microcirculation: A Systematic Review and Meta-Analysis. Chinese Herbal Medicine, 17(3): 584–600.

[38] Pi Y, Zhang X, Jiang T, 2018, Meta-Analysis of Randomized Controlled Trials of Qingyi Decoction in Treatment of Acute Pancreatitis. World Chinese Medicine, 13(06): 1546–1552.

[39] Chen J, Jiang M, Ying Y, et al., 2024, Network Pharmacological Mechanism Analysis and Evidence-Based Medical Validation of Dahuang Mudan Decoction in the Treatment of Acute Pancreatitis. Medicine, 103(37): e39679.