



Research on Empowering Traditional Chinese Medicine Sales Supply Chain with Blockchain Technology

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Abstract. The current sales of traditional Chinese medicine face a series of problems such as lack of trust between trading parties, low logistics and distribution efficiency, and difficulties in financing for small and medium-sized enterprises (SMEs). To address these issues, the research team conducted a study on empowering the traditional Chinese medicine sales supply chain with blockchain technology. Based on the characteristics of blockchain technology, the research team conducted systematic research on transaction security and trust, financing methods, logistics and distribution, and constructed a traditional Chinese medicine blockchain information platform. The results showed that empowering the traditional Chinese medicine sales supply chain with blockchain technology is an important guarantee in the implementation of rural revitalization. It can provide a safe and reliable platform for traditional Chinese medicine sales and effectively solve a series of problems. Therefore, the application of blockchain technology in the traditional Chinese medicine sales supply chain will provide important support and promotion for rural revitalization.

Keywords: Traditional Chinese medicine sales · Blockchain · Supply chain

1 Introduction

Strengthening the work of agriculture, rural areas, and farmers in the northern part of Anhui province and optimizing the supply chain system of traditional Chinese medicine sales are crucial for its stable and healthy economic and social development [1]. However, the current sales of traditional Chinese medicine in the region face some problems, such as the phenomenon of “good production but poor sales,” which seriously hinders rural economic development. Traditional Chinese medicine is also the main source of income for medicinal farmers. Therefore, it is essential to solve the problems of trust, low logistics and distribution efficiency, and enterprise financing difficulties in traditional Chinese medicine sales to achieve poverty alleviation and agricultural stable development.

In 2008, Satoshi Nakamoto published a blockchain white paper entitled “Bitcoin: A Peer-to-Peer Electronic Cash System,” which sparked global interest in blockchain technology. Countries are also actively promoting the development of blockchain-related

industries [2]. Blockchain technology is a new distributed infrastructure and computing paradigm that uses blockchain data structures to verify and store data, uses distributed node consensus algorithms to generate and update data, uses cryptography to ensure the security of data transmission and access, and uses smart contracts to program and operate data [3]. Blockchain technology has technical attributes such as decentralization, consensus mechanisms, and smart contracts and features such as traceability, tamper-proofing, and trustlessness, which are highly compatible with the business requirements of traditional Chinese medicine sales supply chains and can effectively solve the problems in the sales supply chain of agricultural products.

Therefore, studying the application mechanism of blockchain technology in the traditional Chinese medicine sales supply chain field and implementing it has significant practical significance for the smooth progress of rural revitalization in northern Anhui and even the entire country.

2 Problems in the Sales of Traditional Chinese Medicinal Materials

The sales of traditional Chinese medicine face several problems in northern Anhui province, including a lack of trust between trading parties, low logistics and distribution efficiency, and difficulties in financing for small and medium-sized enterprises (SMEs). These issues hinder the development of rural economies and the main source of income for medicinal farmers. Therefore, it is necessary to address these problems to achieve poverty alleviation and agricultural stable development.

2.1 Lack of Trust Between Trading Parties

The lack of trust between traditional Chinese medicine trading parties is a critical factor hindering rural economic development. The absence of trust leads to a lack of information sharing between parties, resulting in poor communication, transparency, and trust between traditional Chinese medicine producers and distributors. Additionally, the lack of trust compromises transaction security and makes it difficult to trace traditional Chinese medicine information [1]. In the traditional Chinese medicine trading mode, without strict auditing and supervision mechanisms, building sufficient trust between trading parties becomes challenging, directly affecting the sales of traditional Chinese medicine and the development of agricultural economies. The lack of funding and logistics supervision in traditional Chinese medicine transactions can result in disputes, making it difficult to recover funds for the damaged parties and impacting the efficiency of transactions and the balance of the traditional Chinese medicine sales supply chain [4].

2.2 Low Logistics and Distribution Efficiency

Modern logistics infrastructure, such as transportation, storage, and handling equipment, is essential to the sales of traditional Chinese medicine. Although logistics companies in northern Anhui have made significant progress in recent years, the logistics system's overall efficiency is still low due to a lack of seamless integration between storage, transportation, and distribution [5]. Furthermore, digital technology is underutilized

in traditional Chinese medicine logistics, making it difficult to mine and analyze data, leading to poor real-time logistics information data sharing and further reducing delivery efficiency.

2.3 Financing Difficulties for SMEs

SMEs play a crucial role in promoting the sales of traditional Chinese medicine in northern Anhui's market. However, rural areas have long been excluded from financial institutions, leading to an inadequate supply of financial services and an increasingly imbalanced supply and demand [6]. Many SMEs struggle to obtain credit loans due to a lack of credit records, exacerbating the imbalance in financial supply and demand. Traditional medicine-related SMEs typically rely on bank loans to meet their financing needs. However, banks usually require collateral, and many traditional medicine-related SMEs lack sufficient collateral to provide, leading to difficulties in obtaining loans and hindering their development. The lack of sufficient loan funds for medicinal farming-related enterprises hinders the operation of the traditional Chinese medicine sales supply chain, ultimately hindering sales. To continue promoting the development of medicinal farming-related SMEs, it is necessary to promote the vitality of the traditional Chinese medicine market. However, the primary obstacle to the development of traditional Chinese medicine enterprises is financing. Only by fully addressing this problem can we provide significant support for the healthy development of rural enterprises.

3 Logical Analysis of Blockchain Technology Empowering Traditional Chinese Medicine Sales Supply Chain

Blockchain technology is a new technology composed of various technologies such as distributed storage, asymmetric encryption, consensus mechanism, and smart contracts. Its main features include decentralization, consensus mechanism, and smart contracts [7, 8]. Through these characteristics, blockchain technology can achieve traceability, anti-tampering, and trustlessness. Literally, a blockchain is a chain composed of a series of blocks, with each block recording specific data information. From a computer perspective, the blockchain is a distributed storage database, and all nodes (i.e., blocks) maintain the database in a decentralized manner, ensuring that the database cannot be tampered with. In the traditional Chinese medicine sales supply chain field, the collaborative supervision and traceability mechanism of blockchain technology can make transaction funds and logistics information open and transparent, helping to achieve full-process supervision of capital flows and whole-process tracking management of traditional Chinese medicine goods. Therefore, blockchain technology has broad application prospects in the traditional Chinese medicine sales supply chain field.

The decentralization feature of blockchain technology is one of its basic characteristics. In the blockchain network, each node is equal, and there is no central server [9]. The trading parties can conduct secure transactions directly in the blockchain without the need for third-party involvement. Using the decentralization feature of blockchain technology, recording the specific data information of traditional Chinese medicine and the trading parties to the corresponding nodes of the blockchain can ensure the good

interaction of traditional Chinese medicine and the trading parties' data information with the blockchain network, while also reducing the involvement of intermediaries, reducing the cost of trading parties, and facilitating the improvement of the organization of various circulation entities. In addition, using distributed ledger technology to store and share traditional Chinese medicine data in a distributed manner helps various trading parties fully understand traditional Chinese medicine, improves the transparency of transactions in the traditional Chinese medicine sales process, and enhances trust between trading parties.

Blockchain technology also has an anti-tampering feature. In the blockchain network, each new data information is verified by all nodes in the entire blockchain network after it is generated [10]. Only verified data information will be added to the blockchain to form a new block. Each node backs up the newly generated data information and stores it permanently. The data information on the node cannot be arbitrarily modified by anyone or technology, thereby ensuring the security and non-tampering of the data information. Using the anti-tampering feature of blockchain, uploading traditional Chinese medicine sales information and consumer information to the blockchain, all information will not be lost and will be permanently valid, ensuring the authenticity of traditional Chinese medicine sales information and the security of consumer information, and providing a safe and trustworthy transaction environment for traditional Chinese medicine sales.

Blockchain technology also has a trustlessness feature [11]. In the blockchain network, any two nodes have established a link that can trust each other, realizing reliable data transmission between peers. Each node in the entire blockchain network plays its own supervisory role, protecting the information security of the trading parties effectively, constructing a value network of mutual trust, and enabling data exchange parties to verify trust information without additional verification. The trustlessness feature of blockchain not only protects the information security of consumers, avoiding the arbitrary disclosure of personal information but also helps agricultural-related enterprises associate with financial institutions for credit, solving the financing difficulties of traditional Chinese medicine enterprises.

4 Mechanism of Blockchain Technology Empowering Traditional Chinese Medicine Sales

4.1 Optimization of Traditional Chinese Medicine Trading Security

In the traditional mode of traditional Chinese medicine trading, the lack of trust between trading parties and the lack of supervision over capital flows limit the further development of agricultural economies. To solve this problem, one of the core features of blockchain technology is to establish a consensus basis for the information on the chain. A traditional Chinese medicine information platform built on blockchain technology can provide peer-to-peer electronic spot trading and services for traditional Chinese medicine, and provide all-round security for transactions.

The trustlessness feature of blockchain technology makes traditional Chinese medicine transactions more secure and reliable. In the traditional Chinese medicine information platform built on blockchain technology, the status of each participating

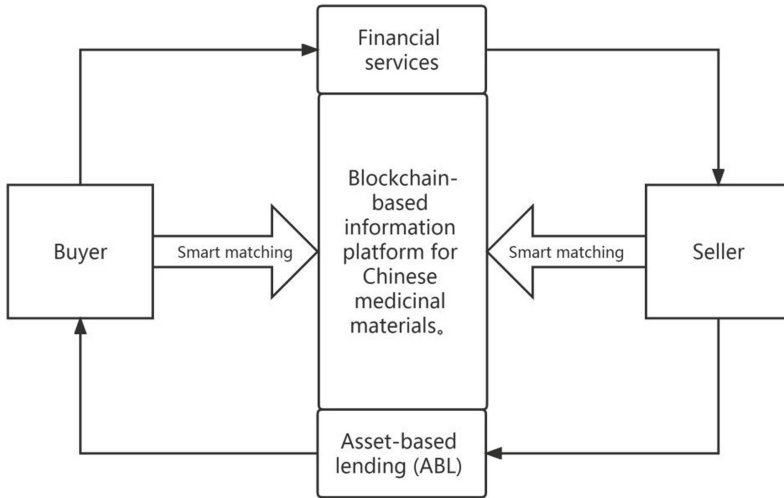


Fig. 1 Blockchain-based trading model for traditional Chinese medicinal materials

node is equal, and transaction information is jointly recorded and maintained based on distributed accounting, ensuring the openness, transparency, and non-tampering of transaction information. After becoming users of the traditional Chinese medicine blockchain information platform, both the buyer and the seller can use the platform to publish transaction information or search for products according to their needs and then negotiate the price. The platform also uses intelligent algorithms to match buyers and sellers.

The blockchain information platform provides financial and asset guarantee services for traditional Chinese medicine transactions and conducts full and dynamic supervision of transaction-related parties, achieving transparency in the traditional Chinese medicine transaction process. This reconstructs the traditional Chinese medicine transaction system, effectively integrating logistics and capital flows, and providing asset guarantee and financial services for traditional Chinese medicine transactions. This makes traditional Chinese medicine transactions traceable and effectively supervised, ensuring the security of traditional Chinese medicine transactions. The traditional Chinese medicine trading model based on blockchain is shown in Fig. 1.

4.2 Optimization of Enterprise Financing Methods

SMEs related to medicinal herbs often face difficulties in financing during their development process, but blockchain technology can provide these enterprises with more scientific credit references [12, 13]. Currently, the weakest link in the medicinal herb supply chain is supply chain finance. In the traditional supply chain system, these enterprises usually obtain financing through channels such as rural credit cooperatives and rural commercial banks. However, due to the lack of credit records, these enterprises have difficulty obtaining credit references from formal channels, resulting in financing difficulties. Blockchain technology is a financial technology that integrates the three

characteristics of decentralization, anti-tampering, and trustlessness. It plays an important role in promoting supply chain financial innovation and development for SMEs related to medicinal herbs.

Blockchain technology ensures the authenticity and traceability of various data information in the process of medicinal herb transactions through technologies such as distributed ledgers, consensus mechanisms, and smart contracts [14, 15]. The traditional Chinese medicine blockchain information platform integrates enterprise information into the financing process, constructs an enterprise credit system, and enables SMEs related to medicinal herbs to break away from traditional financing methods. It forms a debt certificate that can be split and circulated based on the core enterprise, which serves as the financing basis for the enterprise. After being reviewed and verified by the financial financing platform, the system can automatically lend money. For example, during the procurement stage, SMEs related to medicinal herbs, various suppliers, and core enterprises (upstream suppliers of medicinal herbs) reach purchase and sale contracts and apply for warehouse receipt pledging loans from banks and other financial institutions. The bank only needs to review the credit situation and repurchase ability of the core enterprise. Once approved, it can grant credit to the core enterprise. The debt relationship and bond share between the core enterprise and the first-level distributor can be split and transferred to the second-level distributor according to the contract ratio, and the second-level distributor can split it again and pass it down to downstream enterprises until it reaches the bottom-level agricultural SMEs. The blockchain-based financing model for traditional Chinese medicine enterprises is shown in Fig. 2.

By using blockchain technology, data information sharing can be achieved while ensuring the traceability of data information, ensuring that the enterprise credit information provided is authentic and reliable, and solving the financing and credit problems of SMEs related to medicinal herbs at a lower cost from the source. Therefore, optimizing the logistics strategy of traditional Chinese medicine is crucial to ensure the quality and safety of traditional Chinese medicine.

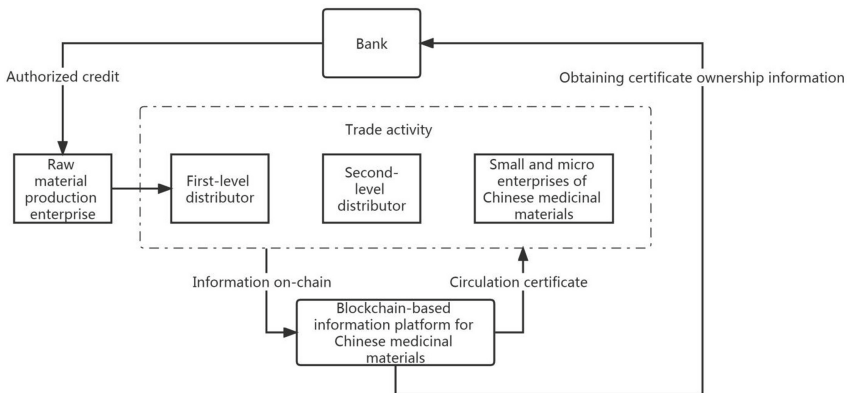


Fig. 2 Blockchain-based financing model for traditional Chinese medicinal materials enterprises

4.3 Optimization Strategy for Traditional Chinese Medicine Logistics

Establishing a Traditional Chinese Medicine Logistics Information Platform.

Establishing a traditional Chinese medicine logistics information platform is the key to optimizing the logistics strategy of traditional Chinese medicine. The traditional Chinese medicine logistics information platform can integrate data from various links in the supply chain and use advanced technologies such as blockchain, IoT, and AI to achieve real-time monitoring, traceability, and management of traditional Chinese medicine logistics information. Through the traditional Chinese medicine logistics information platform, the logistics situation of traditional Chinese medicine can be timely grasped, and various risks in the logistics process can be avoided, thereby improving the quality and safety of traditional Chinese medicine.

5 Strengthening the Quality and Safety Management of Traditional Chinese Medicine

The quality and safety of traditional Chinese medicine are the core issues of traditional Chinese medicine logistics management. In order to strengthen the quality and safety management of traditional Chinese medicine, supervision and management of various links of traditional Chinese medicine should be strengthened. For example, the planting, picking, purchasing, processing, and transportation of traditional Chinese medicine should be strictly controlled to ensure the quality and safety of traditional Chinese medicine. At the same time, a sound traditional Chinese medicine quality and safety traceability system should be established to trace traditional Chinese medicine throughout the entire process to ensure the reliability of the source and quality of traditional Chinese medicine.

6 Optimizing Traditional Chinese Medicine Logistics Management.

Optimizing traditional Chinese medicine logistics management is the key to improving logistics efficiency and reducing logistics costs. To optimize traditional Chinese medicine logistics management, the following measures should be taken:

- (1) Establish a traditional Chinese medicine logistics network. The traditional Chinese medicine logistics network should cover various links in the supply chain of traditional Chinese medicine, such as planting, picking, purchasing, processing, and transportation, to achieve seamless connection and information sharing of traditional Chinese medicine logistics.
- (2) Adopt intelligent logistics technology. Intelligent logistics technology can achieve automation, intelligence, and collaboration in the logistics process, improving the efficiency and accuracy of traditional Chinese medicine logistics.
- (3) Optimize logistics scheduling. Logistics scheduling is the core link of logistics management. Based on the characteristics and requirements of traditional Chinese medicine, scientific and reasonable logistics scheduling strategies should be formulated to improve the efficiency and accuracy of logistics scheduling.

- (4) Strengthen logistics safety management. Logistics safety is an important link in logistics management. Precautions and management of safety risks in the logistics process of traditional Chinese medicine should be strengthened to ensure the safety and compliance of traditional Chinese medicine.

Promoting Green Development of Traditional Chinese Medicine Logistics.

Green development of traditional Chinese medicine logistics is an important direction for optimizing traditional Chinese medicine logistics. To promote green development of traditional Chinese medicine logistics, the following measures should be taken:

- (1) Promote the concept of green logistics. The concept of green logistics is the core of green logistics development. Traditional Chinese medicine logistics enterprises should be guided to establish the awareness of green logistics, adopt green logistics technology and strategies, and reduce environmental pollution and resource waste.
- (2) Promote low-carbon development of traditional Chinese medicine logistics. Low-carbon logistics is an important direction for green logistics. Low-carbon logistics technologies and strategies, such as green packaging, shared transportation, energy saving and emission reduction, should be adopted to reduce carbon emissions in the logistics process, reduce logistics costs and environmental pollution.
- (3) Encourage sustainable development. Sustainable development is the long-term goal of green logistics. Traditional Chinese medicine logistics enterprises should be encouraged to adopt sustainable development strategies, such as resource recycling, resource sharing, and ecological protection, to achieve sustainable development of traditional Chinese medicine logistics.

In summary, optimizing traditional Chinese medicine logistics strategy is an important means to ensure the quality and safety of traditional Chinese medicine. Establishing a traditional Chinese medicine logistics information platform, strengthening the quality and safety management of traditional Chinese medicine, optimizing traditional Chinese medicine logistics management, and promoting green development of traditional Chinese medicine logistics are key measures to optimize traditional Chinese medicine logistics strategy. Traditional Chinese medicine logistics enterprises should strengthen their own management, improve logistics efficiency and quality, and pay attention to environmental protection and sustainable development, making positive contributions to the healthy development of the traditional Chinese medicine industry.

7 Conclusion

With the comprehensive promotion of the Northern Anhui Rural Revitalization Strategy, the development of the traditional Chinese medicine industry as an important part of the rural economy has received extensive attention. However, there are a series of problems in the traditional Chinese medicine sales supply chain, such as information asymmetry, information security, and quality traceability, which seriously restrict the development of the traditional Chinese medicine industry. In this context, the application of blockchain technology has become a powerful tool to improve the transparency, security, and efficiency of the traditional Chinese medicine sales supply chain.

Based on blockchain technology, a decentralized trading platform for traditional Chinese medicine sales supply chain can be established, realizing the autonomy, equality, security, and efficiency of traditional Chinese medicine transactions. This platform can achieve real-time monitoring and traceability of traditional Chinese medicine sales data through blockchain technology, ensuring the authenticity and integrity of transaction data, while enhancing the trust between transaction parties, and improving the security and reliability of traditional Chinese medicine sales. In addition, the application of blockchain technology can also optimize traditional Chinese medicine logistics management and financing methods, improving the efficiency and quality of traditional Chinese medicine sales.

Therefore, the empowerment of blockchain technology is crucial for the development of the traditional Chinese medicine industry. Through the application of blockchain technology, the traditional Chinese medicine sales supply chain can enter a new stage of development, providing powerful support and guarantee for the sales and development of traditional Chinese medicine. This also provides important support for the implementation of the rural revitalization strategy, providing a safe and reliable platform for traditional Chinese medicine sales, effectively solving a series of problems that arise in traditional Chinese medicine sales, and promoting the healthy development of the traditional Chinese medicine industry.

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