

# Research on Empowering the Development of Traditional Chinese Medicine with New Quality Productivity

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**Abstract:** The Traditional Chinese Medicine (TCM) industry, deeply rooted in cultural heritage and complex production processes, has been advancing through technological innovations such as intelligent production systems, digital management, blockchain traceability, and personalized health services. Despite its historical and cultural significance, the integration of these modern technologies offers significant potential to enhance the industry's modernization and internationalization. Empirical research and case studies indicate that adopting intelligent production systems, blockchain-enabled traceability, and data-driven resource management strategies can address industry challenges while promoting sustainable development. This paper examines the current state of new quality productivity in TCM, evaluates the challenges and opportunities of its application, and proposes strategic recommendations for the industry's sustainable growth. The findings suggest that new quality productivity can improve production efficiency, ensure consistent product quality, and boost consumer confidence, particularly in global markets. These insights offer a theoretical foundation and practical strategies for applying advanced productivity models in TCM, with potential implications for other traditional healthcare industries.

**Keywords:** Traditional Chinese Medicine; New quality productivity; Intelligent production; Blockchain traceability; Personalized health services

**Online publication:** December 30, 2024

## 1. Introduction

### 1.1. Background

Traditional Chinese Medicine (TCM) has a rich history and remains an integral component of healthcare systems

worldwide. However, as TCM is rooted in centuries-old practices, its production processes are inherently complex, variable, and difficult to standardize. While TCM continues to enjoy widespread popularity, concerns about product quality, standardization, and regulatory compliance have hindered its growth in international markets.

The principles of new quality productivity—encompassing intelligent production systems, digital management, blockchain-enabled traceability, and personalized health services—present a promising framework for addressing these challenges. These principles aim to enhance efficiency, ensure product consistency, and build consumer trust in TCM products. This study investigates the application of new quality productivity in TCM production, focusing on how technological advancements are transforming the industry <sup>[1,2]</sup>.

## **1.2. Research objectives**

The primary objectives of this study are to evaluate the impact of new quality productivity on production efficiency and product quality in the TCM industry and to provide a strategic framework for its broader implementation. Specifically, the study examines intelligent production systems, digital management practices, blockchain traceability for quality assurance, and the development of personalized health services to meet evolving consumer demands.

## **2. Literature review**

### **2.1. Domestic and international research on TCM modernization**

A growing body of literature examines the integration of modern technology within traditional industries, including TCM. In China, scholars have highlighted that intelligent production systems, such as digital management and blockchain traceability, significantly enhance the production and distribution of TCM products. Studies indicate that advanced manufacturing technologies improve extraction processes, enable quality monitoring, and ensure traceability from sourcing to final products <sup>[2,3]</sup>. Meanwhile, international research focuses on the quality standardization and regulatory challenges TCM faces in foreign markets. For instance, researchers emphasize that consistent quality control is crucial for the acceptance of TCM in Western healthcare systems, where stringent safety and efficacy standards are imposed <sup>[4,5]</sup>.

### **2.2. Core characteristics of new quality productivity in TCM**

New quality productivity in the TCM industry is characterized by three core principles: automation through intelligent devices, comprehensive data integration, and stringent quality control standards. Automation facilitates precise control over production processes, reducing human error and ensuring consistent product quality. Digital integration enables real-time monitoring of each production stage, optimizing resource allocation and improving decision-making. Quality control ensures that TCM products comply with international standards, fostering trust among consumers and regulatory authorities.

## **3. Theoretical framework**

To develop a robust productivity framework for TCM, this study proposes a four-module structure comprising intelligent production, digital management, quality control, and innovation in research and development (R&D). Each module provides a foundation for modernizing TCM production while aligning with industry requirements and international standards.

### **3.1. Intelligent production module**

The intelligent production module incorporates advanced technologies, including the Internet of Things (IoT) and automated equipment, to streamline operations and enhance productivity. Smart sensors monitor environmental variables to ensure optimal conditions for ingredient growth and extraction. Automated systems minimize reliance on manual processes, thereby improving production consistency.

### **3.2. Digital management module**

Digital management enables TCM producers to monitor every production stage through data analytics and digital record-keeping. These systems provide a transparent record of TCM sourcing, production, and distribution, which is essential for ensuring regulatory compliance and building consumer confidence.

### **3.3. Quality control module**

Strict quality control procedures are vital for maintaining product efficacy, especially in international markets. Advanced diagnostic tools and AI-driven analysis monitor and ensure the chemical consistency of TCM products, reducing variability and enhancing reliability.

### **3.4. Innovation and R&D module**

Innovation in R&D is pivotal to the continuous development of TCM. By leveraging AI and big data, researchers can create personalized formulas based on patient data, enabling more targeted treatments. This module also supports the exploration of new medicinal applications for TCM ingredients, thereby expanding the industry's market reach.

## **4. Methodology**

### **4.1. Data collection**

Data were collected from TCM enterprises, healthcare institutions, and research organizations through surveys and in-depth interviews. The surveys targeted TCM practitioners, production workers, and industry executives to explore their perspectives on the current impact of new quality productivity methods and identify potential areas for improvement.

### **4.2. Data analysis**

The analysis focused on quantifying the effects of intelligent production and digital management on TCM's efficiency and quality consistency. Additionally, case studies of successful TCM enterprises that implemented blockchain traceability were examined to evaluate their impact on international consumer trust.

## **5. Results and discussion**

### **5.1. Improving production efficiency and product quality**

The integration of intelligent production systems has significantly enhanced efficiency and product quality within TCM enterprises. Survey data indicates a 15% increase in production efficiency due to IoT-enabled machinery and automated processes that streamline operations and minimize human error. These systems allow precise control

over parameters such as temperature, timing, and ingredient extraction, ensuring uniformity in product output <sup>[6-8]</sup>.

Improved efficiency also addresses a critical challenge in TCM: achieving consistency in active ingredient composition. Automated systems precisely monitor and adjust extraction conditions, reducing batch variability and ensuring therapeutic reliability, particularly for international markets with strict regulatory requirements <sup>[9,10]</sup>.

Digital management tools further enhance traceability throughout the TCM supply chain, tracking processes from raw material sourcing to distribution. This traceability is essential for meeting international quality standards, particularly in regions such as the EU and North America <sup>[10-12]</sup>. These systems provide transparency and facilitate audits by international agencies, bolstering global credibility. Real-time monitoring and predictive analytics further optimize production by identifying and addressing potential issues before they escalate.

In summary, adopting intelligent production and digital management systems improves efficiency, consistency, and transparency, enhancing TCM's global competitiveness and consumer trust.

## **5.2. Supporting the internationalization of TCM**

Blockchain-based traceability has become a pivotal tool for enhancing transparency and facilitating the internationalization of TCM products. With growing global demand for transparency and quality assurance, blockchain technology ensures an immutable record of each product's journey from raw material sourcing to distribution. Survey data reveals that over 60% of TCM enterprises employing blockchain reported improvements in navigating regulatory requirements and gaining access to markets like Europe and North America, where strict standards pose significant barriers to traditional herbal medicines <sup>[13-15]</sup>.

Blockchain technology guarantees that every step of the TCM production process is recorded and unalterable, thereby building consumer trust in unfamiliar markets. It assures consumers of sustainable sourcing, hygienic processing, and rigorous testing, reinforcing confidence in product safety and efficacy.

For TCM companies, blockchain simplifies compliance with audits and regulatory checks, facilitating market entry in highly regulated regions. It also helps prevent issues such as counterfeit products and compromised batches, safeguarding brand reputation. Real-time access to supply chain data enables companies to quickly identify and address potential quality concerns.

Moreover, blockchain highlights ethical and sustainable practices, such as responsible herb harvesting and fair-trade labor, appealing to consumers who prioritize sustainability. This ethical transparency provides TCM brands with a competitive edge in global markets.

In conclusion, blockchain enhances TCM's global competitiveness by improving transparency, regulatory compliance, and ethical practices, making TCM products more reputable and marketable internationally.

## **5.3. Advancing sustainable development**

The transition to data-driven resource management has advanced sustainability within the TCM industry. Given TCM production's reliance on water, energy, and herbal resources, data-driven approaches supported by big data analytics and IoT technology optimize resource consumption, reduce waste, and minimize environmental impact.

Survey results indicate that TCM companies utilizing data analytics have significantly reduced resource usage. For instance, one company monitored water consumption using big data, achieving a 20% reduction, which is particularly valuable in water-scarce regions <sup>[15]</sup>.

Data analytics also optimizes the use of raw herbal materials. IoT devices track soil conditions and weather patterns, improving harvest timing and ingredient quality while reducing waste. These practices lead to cost

savings, lowering operational expenses and enhancing the competitiveness of TCM products in domestic and international markets.

Furthermore, data-driven resource management increases accountability and transparency, enabling companies to document and report sustainability efforts to regulatory bodies and consumers. As international markets increasingly emphasize sustainability, this transparency strengthens the reputation of TCM brands.

Data-driven practices align with the TCM philosophy of balance and respect for nature. By integrating technology with ecological considerations, the TCM industry can modernize while adhering to its cultural values, appealing to both traditional consumers and sustainability-focused audiences.

In conclusion, data-driven resource management fosters sustainability in TCM by optimizing resource allocation, reducing environmental impact, and improving transparency, positioning TCM companies as responsible and competitive players in global markets.

## **6. Recommendations**

### **6.1. Policy support**

To enable the TCM industry to effectively integrate new quality productivity (NQP) models, robust governmental support through well-designed policies is essential. This support should target not only large enterprises but also small and medium-sized enterprises (SMEs), which often lack the resources to adopt advanced technologies. Financial incentives such as grants or subsidies can encourage SMEs to invest in IoT-enabled machinery, blockchain systems, and digital management tools, with tax relief further reducing financial barriers<sup>[10]</sup>.

Governments should establish favorable regulatory frameworks to streamline digital management and blockchain adoption in TCM production. Simplified requirements would reduce administrative burdens, accelerating the adoption of NQP practices. Industry-specific innovation grants could further promote smart manufacturing across the sector.

For global market expansion, aligning domestic quality standards with international certification requirements is critical. Collaborative frameworks with international regulatory bodies such as the European Medicines Agency (EMA) or the U.S. Food and Drug Administration (FDA) would help TCM products meet stringent overseas standards, improving global competitiveness.

Additionally, export promotion programs could assist TCM companies in navigating international regulations and positioning their products as trusted healthcare alternatives. Sustainability incentives, including grants for water-saving technologies, would further encourage eco-friendly practices, aligning production with ecological values and the growing market demand for sustainable products<sup>[12]</sup>.

### **6.2. Innovation and R&D investments**

Investment in innovation and R&D is essential for maintaining the TCM industry's competitiveness and meeting evolving consumer expectations. Prioritizing R&D in AI-driven intelligent production, advanced digital management, and personalized health services can significantly enhance efficiency and innovation. AI integration can optimize ingredient extraction, quality control, and product customization, while predictive analytics can streamline production and reduce costs.

R&D should also focus on developing personalized health solutions through big data and machine learning, tailoring TCM treatments to individual needs. This would improve credibility, especially in Western markets where

personalized medicine is increasingly valued. The development of digital health platforms integrating TCM with modern diagnostics can create a bridge between traditional and contemporary healthcare systems.

Collaborations with research institutions and universities can accelerate innovation, granting TCM companies access to cutting-edge knowledge, advanced technologies, and expert researchers. Joint research initiatives and dedicated research centers focused on modernizing TCM would ensure continuous innovation.

Governmental incentives, including competitive grants and public-private partnerships, could offset R&D costs and encourage collaborative efforts. Tax incentives for R&D expenditures would further motivate investment in innovation.

In addition, eco-friendly production methods should be a focus area for R&D. Investing in green technologies can reduce the environmental footprint, improve resource efficiency, and appeal to environmentally conscious consumers. These initiatives would align the industry with global sustainability goals, helping TCM meet both technological and ecological demands in the global market.

### **6.3. Talent development**

A skilled workforce is vital for the successful adoption of NQP models in the TCM industry. Talent that combines traditional TCM knowledge with modern technological expertise is essential for managing and optimizing advanced systems. Educational institutions can support this by offering interdisciplinary programs that integrate TCM with digital technologies, data science, and AI, preparing professionals for digitally advanced environments.

Universities and vocational institutions should develop specialized TCM technology programs that cover IoT, blockchain, and data-driven resource management. These programs should also emphasize quality assurance, ethical sourcing, and consumer transparency. Internships and cooperative education programs with TCM companies can provide practical experience, easing the transition of students into the workforce.

Ongoing training for existing employees is equally important. TCM companies should offer workshops, seminars, and certification programs focusing on intelligent production and blockchain traceability. Upskilling initiatives in AI and data analytics can further enhance workforce capabilities, enabling employees to maximize the potential of new technologies. Companies could incentivize learning by offering rewards for advanced training completion.

To attract top technical talent, TCM companies should recruit experts in AI, machine learning, and blockchain by offering competitive salaries, flexible working conditions, and clear career progression opportunities. International recruitment could also provide fresh perspectives and insights.

Government support is crucial for talent development. Public funding for scholarships and training grants can build a sustainable talent pipeline. Tax credits for companies investing in workforce development would further encourage training initiatives.

In conclusion, collaboration among educational institutions, TCM companies, and government entities is essential for developing a skilled workforce capable of ensuring the successful integration of NQP practices in TCM <sup>[11-13]</sup>.

## **7. Conclusion and Future Directions**

This study highlights the substantial potential of integrating new quality productivity principles into the Traditional Chinese Medicine (TCM) industry to enhance production efficiency, product quality, and global competitiveness.

The adoption of intelligent production, blockchain traceability, and data-driven management enables TCM enterprises to align with the expectations of modern consumers and comply with stringent regulatory standards in international markets.

Future research should prioritize optimizing intelligent production systems, improving the scalability of blockchain technology, and advancing personalized health solutions to fully realize the benefits of new quality productivity in TCM. These efforts will not only solidify TCM's position in the global market but also contribute to the modernization of traditional medicine industries worldwide.

The findings of this research provide a robust foundation for other traditional medicine sectors to pursue similar pathways toward innovation, sustainability, and internationalization <sup>[8,9]</sup>.

## Funding

Humanities and Social Science Research Project of Guizhou Provincial Department of Education (Project No. 24RWZX057)

## Disclosure statement

The authors declare no conflict of interest.

## References

- [1] Zhang M, Jiang F, Chen Y, et al., 2024, Research on Empowering High-Quality Development of Traditional Chinese Medicine with New Quality Productivity Based on Rainbow Model. *Chinese Hospital*, 28(7): 12–15.
- [2] Huang M, Yang F, Wang Y, et al., 2024, Strategies and Reflections on Empowering Traditional Chinese Medicine Inheritance, Innovation, and Development with New Quality Productivity. *Tianjin Traditional Chinese Medicine*, 41(7): 935–938.
- [3] Chen Y, Yan H, 2024, Research and Prospects on the Green, Low-Carbon, and High-Quality Development of the Traditional Chinese Medicine Resource Industry Empowered by Technology. *Modern Management Science*, 2024(3): 56–61.
- [4] Wan Y, Xue Q, You M, et al., 2024, Exploration of the Development of New Quality Productivity in Traditional Chinese Medicine from the Perspective of Hospitals. *Jiangsu Health Service Management*, 35(8): 1092–1094.
- [5] Li L, Li W, Su Y, et al., 2024, Exploring the New Path of Intelligent Transformation and Upgrading of Traditional Chinese Medicine Processing Under the Background of “New Quality Productivity”. *Journal of Nanjing University of Traditional Chinese Medicine*, 40(7): 653–660.
- [6] Intelligent Manufacturing Empowers Traditional Chinese Medicine Enterprises to Unleash New Quality Productivity, n.d., 2024. *Securities Market Weekly*, 2024(6): 34.
- [7] Xiao B, 2024, Grasp the Focus of Developing New Quality Productive Forces. *New Xiang Review*, 2024(10): 27.
- [8] Tai P, Wang X, 2022, Political and Economic Analysis of Promoting High-Quality Development of Traditional Chinese Medicine in the New Era. *Political Economy Research*, 2022(4): 72–81.
- [9] Official Website of the State Administration of Traditional Chinese Medicine, *China Journal of Traditional Chinese Medicine*, Science and Technology Daily, 2024, Support for Providing Integrated Healthcare Services, Including Traditional Chinese Medicine, for the Elderly. *Traditional Chinese Medicine Health Preservation*, 10(6): 2.

- [10] Zhu Z, 2024, Research on Fiscal and Financial Support for the Development of Characteristic Industries in Ethnic Regions Under the Background of New Quality Productivity. *Regional Finance Research*, 2024(7): 60–66.
- [11] Shi H, Luo X, Chen L, 2024, Exploring the Optimization of Collaborative Governance in the Development of China's Health Industry from the Perspective of New Quality Productivity. *Journal of Jiangxi University of Traditional Chinese Medicine*, 36(3): 106–110.
- [12] Chen X, 2024, The Combination of Artificial Intelligence and Traditional Chinese Medicine is an Inevitable Trend. *China Science and Technology Wealth*, 2024(6): 23–25.
- [13] Hou Z, Liu F, Chen X, et al., 2016, Evidence-Based Scales: Directions for Breaking Through the Dilemma of Clinical Outcome Evaluation Under the Productivity of Modern Traditional Chinese Medicine. *Chinese Journal of Traditional Chinese Medicine*, 31(10): 3872–3877.
- [14] Xie Y, Wang L, 2015, The Clinical and Social Value of Traditional Chinese Medicine Research: On the Transformation of Traditional Chinese Medicine Scientific and Technological Achievements. *Journal of Traditional Chinese Medicine*, 56(24): 2079–2082.
- [15] Du X, 2024, Exploring the Path to Achieving High-Quality Development of Traditional Chinese Medicine Service Trade Under the New Development Pattern. *Modern Distance Education of Traditional Chinese Medicine in China*, 22(5): 154–158.

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