Design and Implementation of Django-based Quality Traceability System for Medicinal Dendrobium

Yonghu Chang[1,a], Shuiping Ou[2,b], Qihai Jia[3,c], Mingbo Mo[3,d], Sen Wang[4,e*]

[1]School of Medical Information Engineering, Zunyi Medical University, Zunyi 563000, China
[2]Department of Pharmacy, Affiliated Hospital of Zunyi Medical University, Zunyi 563000, China
[3]Guizhou Chishui Guoli Dendrobium nobile Development Co., Ltd., Zunyi 564707, China
[4]School of Pharmacy, Zunyi Medical University, Zunyi 563000, China

E-mail: [a]stu360@foxmail.com@foxmail.com, [b]oushuiping1208@126.com, [c]2624743406@qq.com, [d]474266077@qq.com, [e*]wangsen@zmu.edu.cn

Abstract. Taking Dendrobium nobile as an example, a quality traceability system for the entire production process of medicinal Dendrobium was constructed. The server program of Dendrobium nobile quality traceability system is built by django, the back-end data submission and request interface of the system is built by django rest framework, the desktop web interface is built by elementUI based on VueJs, and the mobile phone application of the system is built by uniapp framework.The Dendrobium nobile quality traceability system can record, save and query the production process data of breeding, cultivation, harvesting and processing, quality detection of Dendrobium nobile products, and transmit them to consumers in real time and accurately to ensure the reliability of product sources and quality, and improve the consumer loyalty of Dendrobium nobile products. The research and development of this system can realize the quality management and information query of the whole industrial chain of Dendrobium nobile, provide an important basis for regulating the Dendrobium nobile industry in Chishui, improving product quality and brand influence, and provide reference for the development and application of the quality traceability system of medicinal Dendrobium nobile.

Keywords: dendrobium nobile; traceability; big data; django; django rest framework

1 Introduction

Dendrobium spp. encompasses perennial herbaceous plants that belong to the genus Dendrobium in the Orchidaceae family. The genus Dendrobium consists of around 1,500 species. Among the 75 species and two variants found in China, nearly 50 have medicinal properties [1]. The medicinal use of Dendrobium dates back to the earliest records in the "Sheng Nong's herbal classic."[2] Dendrobium is classified as a superior-grade traditional Chinese medicine renowned for its properties in nourishing

C. Chen et al. (eds.), *Proceedings of the 3rd International Conference on Digital Economy and Computer Application (DECA 2023)*, Atlantis Highlights in Computer Sciences 17,
https://doi.org/10.2991/978-94-6463-304-7_65

the stomach, generating body fluids, nourishing Yin, and clearing heat. Throughout the course of over two thousand years, significant variations in the sources of medicinal Dendrobium species have occurred. The 2020 edition of the "Chinese Pharmacopoeia" lists two types of Dendrobium: Dendrobium and Tiepishihu. The Dendrobium category comprises species such as Dendrobium nobile Lindl., Dendrobium huoshanense C. Z. Tang et S. J. Cheng, Dendrobium chrysotoxum Lindl., and Dendrobium fimbriatum Hook [3]. Studies have revealed that diverse Dendrobium species can be effectively distinguished through 17 microscopic structures and infrared (IR) identification methods. Moreover, disparities in the microscopic structures and constituents of Dendrobium can be observed under varying growth conditions [4-7].

The production of Dendrobium medicinal materials involves a complex, multi-stage process that spans from cultivation to clinical application. This process necessitates various growth environments and processing procedures. Establishing a comprehensive, regulated, and traceable system is imperative to ensure the safety, efficacy, stability, and quality control of Dendrobium medicinal materials. Presently, China's Dendrobium industry operates under a decentralized management structure, lacking efficient tracking and regulatory mechanisms to guarantee the quality of Dendrobium medicinal materials in the hands of end-users. In case of quality incidents, promptly identifying the source of the issue and implementing timely corrective measures poses challenges. Hence, there is an urgent need for the establishment of a comprehensive and effective Dendrobium traceability system.

2 Traceability Technologies and the Traceability System for Dendrobium spp.

2.1 Theoretical foundation

The Dendrobium quality traceability system is an essential mechanism for ensuring the quality of Dendrobium products by employing technologies like the Internet of Things (IoT) and data exchange via the internet. Currently, the Dendrobium industry lacks a well-established quality traceability system. The technical methods employed primarily draw from the experiences of traditional Chinese medicine quality traceability systems and other industries, including agricultural product traceability [8-9] and industrial product traceability [7]. These industries' traceability systems rely on two key technological components. The first component is the data transmission and sharing system, encompassing database technology [11], internet service technology [12], software engineering technology [13], web technology, and mobile technology [14]. The second component is the IoT technology service system, integrating RFID technology [15-16], barcode technology [17-18], data collection technologies for environmental factors such as temperature and humidity, and audio-video collection technology [19]. Currently, quality traceability methods for Chinese medicinal materials include DNA identification [20], traditional Chinese medicine chemical fingerprinting [21], isotope tracing technology [22], RFID radio frequency

technology, and barcode technology [23]. Barcode technology can be categorized into one-dimensional and two-dimensional codes based on coding dimensions. Compared to one-dimensional codes, two-dimensional codes offer advantages such as larger information storage capacity, increased security, convenience, stability, and extensive support in smartphone apps. As a result, they find widespread application across various industries, including Chinese herbal medicine warehouse management, logistics, and Good Agricultural Practices (GAP) production processes. Consequently, two-dimensional codes are the preferred choice for label and code production technologies.

Since the implementation of the Traditional Medicine Act in Europe and the United States in 2004 and the establishment of the National Chinese Medicinal Materials Traceability System by the Ministry of Commerce in China in 2012, significant domestic enterprises, research institutions, and large pharmaceutical groups have actively responded to the initiative and developed their respective herbal medicine traceability systems, resulting in a thriving construction boom in the industry. However, during this period, there was no designated unified standard for the traceability system, which impeded information exchange among enterprises, government agencies, associations, and research institutions [24]. On March 3, 2017, the "Guiding Opinions on Promoting the Construction of Information-based Traceability System for Important Products" was officially released. This document emphasized the need to enhance the traceability standard system and strengthen the Chinese medicinal materials traceability system by 2020. In accordance with these guidelines, the establishment of a quality traceability system for Dendrobium becomes an urgent requirement in order to facilitate the sound and rapid development of the Dendrobium industry.

2.2 Analysis of the Current Status of the Quality Traceability System for Dendrobium spp.

Aceability System for Important Products" was issued. The document stated that by 2020, it is necessary to improve the traceability standard system and consolidate and enhance the Chinese medicinal materials traceability system. Under the guidance of this document, in order to promote the sound and rapid development of the Dendrobium industry, it is urgent to establish a quality traceability system for Dendrobium.

Although the Dendrobium industry lacks a quality traceability system at present, it is categorized under traditional Chinese medicine. An assessment and examination of the existing traceability systems for traditional Chinese medicine reveal several notable characteristics.

Regarding traceability technologies, the techniques employed in traditional Chinese medicine products share similarities with those used in agricultural products but lack standardization. Various industries utilize one-dimensional barcodes, two-dimensional barcodes, and RFID technologies. However, DNA identification and isotope discrimination, despite being less frequently used in traditional Chinese medicine identification, are cumbersome and destructive, making them impractical for

large-scale and widespread traceability systems [9]. The adoption of RFID technology is hindered by the requirement for specialized equipment for data retrieval[10]. In contrast, two-dimensional barcode technology, with its ability to store more information, represents a suitable choice for quality traceability systems as it builds upon and extends the capabilities of one-dimensional barcode technology.

In terms of traceability standards, while quality traceability systems for traditional Chinese medicine are more commonly applied to finished Chinese patent medicines, further comprehensive research is necessary to establish traceability standards for medicinal Dendrobium [25]. There is currently a lack of corresponding systems and standards for the comprehensive tracking of medicinal herbs, herbal pieces, semi-finished products, and finished Chinese patent medicines [26].

Regarding traceability content, the information encompassed in the traceability of traditional Chinese medicinal materials typically includes the cultivation process, management process, harvesting process, processing process, and distribution process. This information can be collected through IoT detection devices or manual recording, resembling the traceability systems utilized for agricultural products..

2.3 Internet of Things (IoT) Technology

Through research on the differences and commonalities between the quality traceability systems for traditional Chinese medicine and agricultural products, it has been found that the quality traceability system for Dendrobium requires not only tracking the entire cultivation and processing process of Dendrobium but also monitoring its growth environment, reflecting the rigorousness and safety of its medicinal properties. This imposes higher requirements on the software engineering and Internet of Things (IoT) technology foundations of the Dendrobium traceability system. In the design and development process of this system, the system is divided into four layers, including the UI user interface layer, the Web Service business logic layer, the DAL data access layer, and the IoT Internet of Things device layer.

The UI interface layer serves as a platform for various functionalities in the Dendrobium traceability system. It enables growers and processors to manage Dendrobium production data, allows production personnel to generate and print traceability codes, and enables end users to scan codes and retrieve product information. The UI interface can be developed for either PC or mobile platforms, with some similarities and differences in the development techniques employed for each. Typically, the data structure is written in Extensible Markup Language (XML), Cascading Style Sheets (CSS) define the data presentation style, and JavaScript is used for page interaction logic and communication with the web service.

The Web Service layer acts as an intermediary between users and data. It processes and validates data before presenting it to users and before it is entered by users, functioning as a data processing factory. This layer primarily implements key business invocation interfaces for the Dendrobium traceability system and facilitates data transmission across different layers and platforms. To ensure universality and scalability, all interfaces in the Web Service layer adhere to the RESTful API specification. Multiple development technologies and frameworks are available for

this layer, including PHP, Python, and Java. PHP frameworks such as ThinkPHP and Yii, Python frameworks like Django and Flask, and Java frameworks like Spring Boot and jFinal are popular choices. Each framework has distinct characteristics, with Django offering fast development speed and suitability for rapid prototyping, while Spring Boot is widely recognized for its maturity and popularity, making it suitable for large-scale web service development [27]. Considering these factors, the Django framework will be utilized for the development of this system.

The Data Access Layer (DAL) primarily facilitates database connection access, data querying, and data manipulation. To ensure data security and integrity, the database only accepts data operations from the Web Service layer and stores validated data.

The IoT service employs Internet of Things technology to establish a sensor network for collecting data and audio/video information related to factors like temperature, humidity, and soil conditions during Dendrobium cultivation and processing. This module relies on embedded devices to transmit sensor-collected information to the Web Service layer for validation and storage.

Based on the aforementioned components, it is evident that the development of IoT technology and software engineering adequately supports the hardware and software requirements of the Dendrobium quality traceability system. The effectiveness of the traceability system relies on the design of its business logic. To validate the proposed design strategy, a specific architecture for the quality traceability system was developed using Golden Whisker Dendrobium as an example. The system was subsequently implemented, deployed, and subjected to testing.

3 Design of the Dendrobium Traceability System

The primary objective of this traceability system is to ensure the continuous supervision and management of Dendrobium throughout its entire process, from seedling cultivation to end-user sales. This is done to guarantee the quality and safety of the product. The system utilizes the widely adopted two-dimensional QR code electronic label as the traceability label. Once Dendrobium products are processed and packaged, a unique QR code electronic label is attached to each product package. The QR code contains essential information about the Dendrobium, including details about cultivation, planting, harvesting, processing, quality testing, as well as product-specific information such as serial number, product name, origin, price, and production date. Since product information has a simple structure and limited content, it can be directly encoded and stored in the QR code. However, cultivation and processing information, due to its complex structure and large volume of data, exceeds the maximum encoding capacity of the QR code. As a result, this information is stored in the background information server of the traceability system. The server is connected to QR code scanning terminal devices through an information sharing platform, enabling users to scan the code and access comprehensive traceability information..

3.1 Traceability Information Basic Content

3.1.1 Seedling Cultivation

Seedling cultivation, also known as greenhouse seedling cultivation, aims to rapidly propagate Dendrobium seedlings in greenhouses. It plays a role in "breeding" throughout the entire Dendrobium cultivation process. Different lighting, temperature, humidity, and substrate conditions can affect the growth and development of seedlings, thereby influencing the quality of the final Dendrobium products. Therefore, in this stage, the traceability system should record the source, substrate, transplantation, and field management processes of the seedlings. Since field management is a continuous labor-intensive process, each batch of seedling cultivation corresponds to a set of records for the source, substrate, and cultivation, along with multiple field management records. Field management records include fertilization, weeding, moisture, lighting, and temperature.

3.1.2 Cultivation

Dendrobium seedling cultivation methods include greenhouse raised beds, simulated wild rock cultivation, and simulated wild tree cultivation. Studies have shown that the agronomic characteristics of Dendrobium cultivated using these three methods differ significantly. Therefore, in this stage, the traceability system needs to record the growth conditions such as altitude, humidity, shading, air, and water sources, as well as factors that affect the quality of Dendrobium, such as cultivation methods and cultivation time. In addition, field management also affects the quality of Dendrobium, so processes such as moisture, lighting, shading, cleaning, weeding, pruning, and pest control need to be recorded.

3.1.3 Harvesting and Processing

The medicinal parts of Dendrobium are the flowers and stems. In this stage, the processing steps for flowers are relatively simple and involve picking, drying, and packaging. The stems can be processed into fresh strips or sliced. The processing steps for fresh strips include picking, soaking, washing, drying, and grading packaging. The processing steps for slices include picking, soaking, washing, drying, cutting, roasting, sweating, roasting again, and packaging. The processing location and each stage can impact the product's quality and need to be recorded.

3.1.4 Quality Testing

Quality testing is conducted by third-party testing agencies to determine the quality of Dendrobium products by examining factors such as the growth climate, water quality, soil heavy metals, pesticides, and air. These tests provide certification reports that serve as quality assurance for the products.

In addition to the above basic information, the system uses Internet of Things (IoT) devices to monitor environmental factors such as temperature and humidity during cultivation and cultivation in real-time, aiming to reduce the workload of management personnel. Simultaneously, video streaming technology is used to capture real-time

images of the planting and processing processes, allowing end-users to visually observe the entire growth environment and processing flow of Dendrobium products through videos.

3.2 Traceability Information Basic Content

The traceability system consists of a data center and two public service systems. The functionalities and data of the data center and the public service systems are designed to be separate. The exchange of data between the data center and the public service platforms follows the RESTful specification using JSON data format. The overall architecture of the traceability system is illustrated in Figure 1.

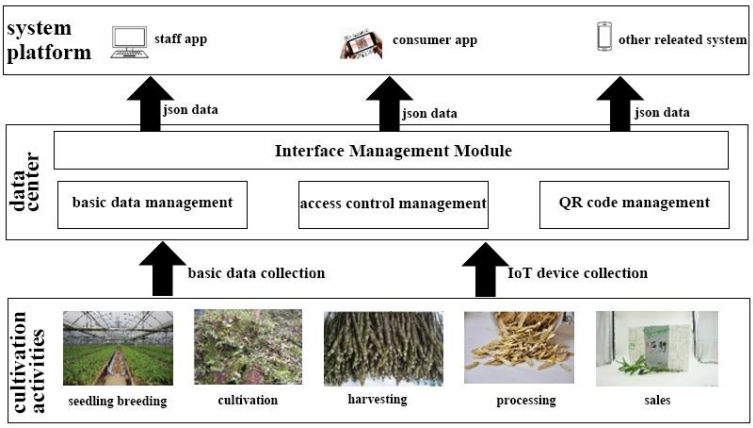

Fig. 1. Overall structure of Dendrobium traceability system

The data center primarily consists of four modules: basic data management, permission management, QR code label management, and RESTful API management. The RESTful API management module serves as the data portal within the data center, and all data interactions with the data center must go through this module. Therefore, the data center not only provides data support for the management side (such as for staff members) and end-users but also offers data exchange support for any other systems that comply with the RESTful API specification.

4 The implementation of the Dendrobium Traceability System

4.1 Technical Architecture:

The data center and service platforms have different primary functions. The data center is primarily responsible for data processing. Therefore, it utilizes MySQL as the underlying database system, Python as the main programming language, Django as the web server development framework, and Django Rest Framework (DRF) as the RESTful API development framework. By leveraging Django's built-in ORM, Model, and Router components, a commercial-grade web server program can be developed

rapidly. The viewset method provided by DRF ensures the generation of consistent and structured API interfaces.

The two service platforms are developed using an H5 approach, with Vue.js as the JavaScript development framework. The staff management platform adopts ElementUI as the interface development framework, while the end-users are served through the UniApp framework for mobile app development. The overall development structure is illustrated in Figure 2.

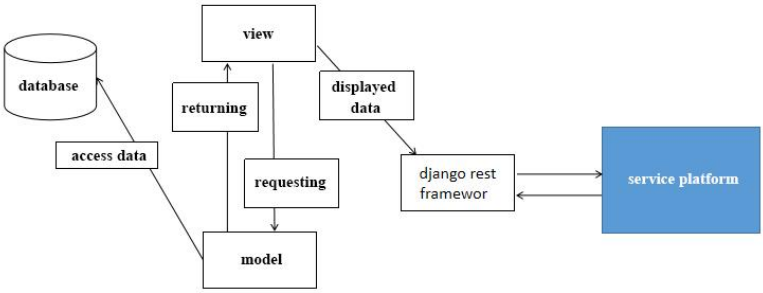

Fig. 2. Interoperability diagram of each module of Dendrobium traceability system

4.2 Software functionality of the traceability system

From a design perspective, the overall functionality of the traceability system can be divided into the following categories:Permission Management,Alert Functionality,Environmental Data Management,QR Code Verification,Interface Management.The organizational structure of these functionalities is illustrated in Figure 3.

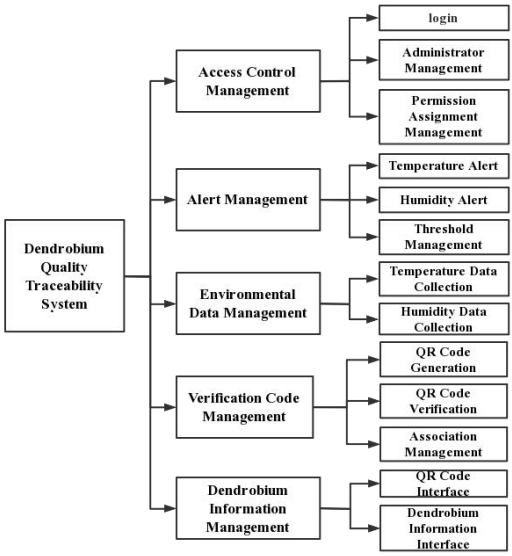

Fig. 3. Functional organization chart of Dendrobium quality traceability system

The Alert Management module primarily monitors environmental data based on pre-set thresholds by administrators. If the monitored data exceeds or falls below the thresholds, the administrators are alerted. The Environmental Data Management module focuses on the collection and organization of temperature and humidity data. The administrator's operational interface includes the following modules: Seed Breeding (Figure 4(a)), QR Code Management (Figure 4(b)), and Temperature and Humidity Monitoring with Alert (Figure 4(c)).The QR Code Verification module automatically generates a unique QR code for each product((Figure 4(d))). Users can scan the QR code using their mobile phones to access and view the relevant information of the current product. The interface for end-users after scanning the QR code on their mobile phones is depicted in Figure 4(e).

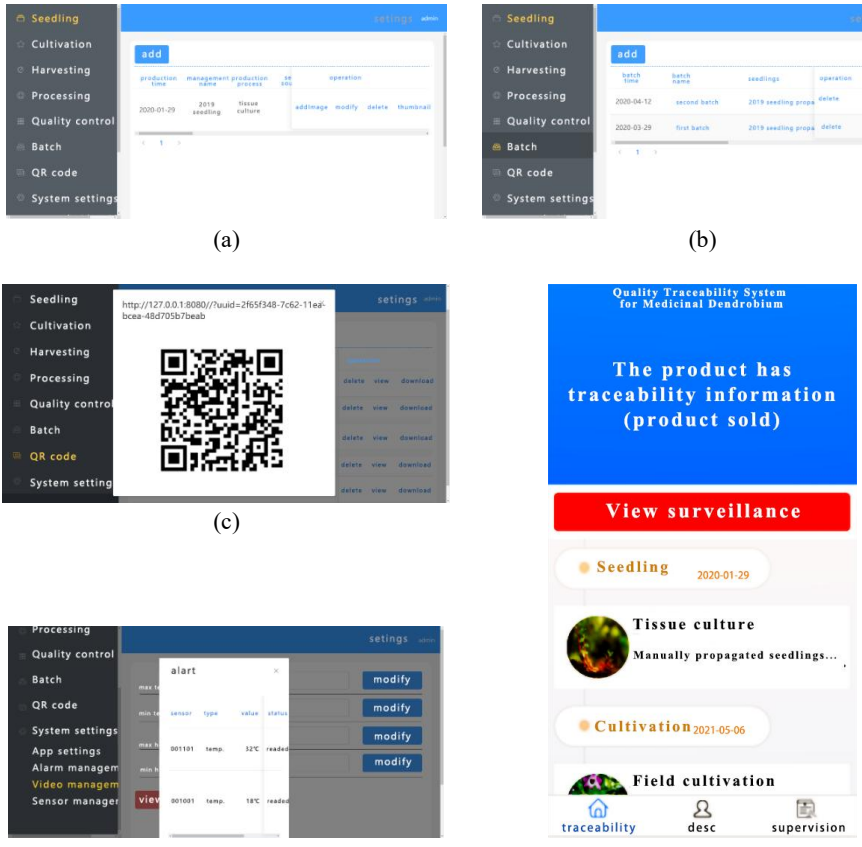

Fig. 4. Operation interface of Dendrobium quality traceability system

5 Conclusion

The COVID-19 pandemic has swept across the globe, garnering significant attention for traditional Chinese medicine (TCM). The promotion of TCM's revitalization and development has become a national strategic focus. The high-quality development of the Chinese medicinal materials industry plays a pivotal role in the comprehensive revitalization of TCM and serves as the cornerstone of quality control for Chinese medicinal materials. In recent years, the cultivation area of Chinese medicinal materials in China has experienced continuous expansion, with the Ministry of Commerce projecting it to exceed 66.2 million acres by 2020. However, the quality of Chinese medicinal materials still faces numerous challenges, including poor controllability, inadequate regulation of inputs such as pesticides and fertilizers, and a lack of quality traceability systems.

This study focuses on the development of the Dendrobium officinale industry in China and the progress of traceability solutions for Chinese medicinal materials. A comprehensive software and hardware solution for ensuring the quality traceability of Dendrobium officinale was proposed and implemented. A traceability query system was constructed to cover key stages of Dendrobium officinale production, including seedling breeding, cultivation, harvesting, processing, quality testing, and sales. The system achieved transparency in each production and processing stage through an internet-based approach. This traceability solution not only enhances the quality of Dendrobium officinale products but also improves their brand reputation and market competitiveness, thereby promoting the healthy and orderly development of the entire Dendrobium officinale industry.

The solution employed various key technologies, including QR codes, sensors, live video streaming, databases, and H5. Process data corresponding to each stage of Dendrobium officinale production was collected and stored in a database. Administrators could interact with the database in real-time, edit data from each production stage, ensure the timeliness of information, and automatically provide consumers with precise production process data based on the product's QR code. This ensures that consumers have a comprehensive understanding of the entire production process of the purchased Dendrobium officinale product, addressing their demand for high-quality products through process transparency.

The designed solution for the quality traceability system of medicinal Dendrobium officinale was deployed and tested at the organic Dendrobium officinale planting bases of Guoli Jinchaishihu Development Co., Ltd. in Yuhuang Village, Guandu Town, Chishui City, Guizhou Province (Base Certificate No.: 001OP1700141, Huangjinping Dendrobium officinale Base, and Changwugan Dendrobium officinale Base in Yuhuang Village). The system has been preliminarily validated in achieving the goals of managing and querying traceability information for Dendrobium officinale products. However, there are areas that can be improved and refined. During the cultivation stage of Dendrobium officinale, besides automatically collecting temperature, humidity, and real-time video information, manual management by administrators is still required for other basic information. This aspect needs improvement in future design and development. It is necessary to fully utilize

the characteristics of electronic tags to reduce the data maintenance cost for administrators and ensure the authenticity of data sources.

Acknowledgment

This work is supported by the Guizhou Provincial Science and Technology Support Project (No.Qian Science Support [2018] 2804) and the Scientific Research Project of Guizhou Dendrobium Industry Development Research Center (No.QSKH[2019003]-002) and the Guizhou Province Education Department, Characteristic Region Project (No.Qian Education KY [2021] 072) and Future Master Medical Technician Talent Cultivation Program of Zunyi Medical University.

References

1. Li, Q., Yang, Y, L., Peng, C., et al. (2018) Research Progress of Medicinal Dendrobium [J]. Journal of Agriculture, 8(10):61-64. https://doi.org/10.11923/j.issn.2095-4050.cjas18030007.
2. Luan, Y, J., Hou, W, S. (2010) Shennong Materia Medica [M]. People's Military Medical Press, Beijing, 61-62.
3. Chinese Pharmacopoeia Commission. (2020) Pharmacopoeia of the People's Republic of China [S]. China Press of Traditional Chinese Medicine, Beijing.
4. Rao, Y., Wang, M, Y., Zhao, W., et al. (2023) Research progress on identification methods of medicinal dendrobium [J]. Drug Evaluation, 20(01):1-5. https://doi.org/10.19939/j.cnki.1672-2809.2023.01.01.
5. Tang, D, P., Lu, A, J., Ling, L., et al. (2020) A Comparative Study of Dendrobium Epiphyticum of Different Tree Species Based on UPLC-MS Principal Component Analysis [J]. Journal of Zunyi Medical University, 43(2):151-154. https://doi.org/10.14169/j.cnki.zunyixuebao.2020.0031.
6. Zeng, Y., Lu, A, J., Tan, D, P., et al. (2020) Comparative Analysis of Polysaccharide Content of Dendrobium Dendrobium under Different Cultivation Methods [J]. Journal of Zunyi Medical University, 43(2): 174-178.https://doi.org/10.14169/j.cnki.zunyixuebao.2020.0035.
7. Lu, A, J., Yu, D, D., He, H, Y., et al. (2020) Comparison of the Content of Dendrobine in Dendrobium Aureus Population [J]. Journal of Zunyi Medical University, 43(1):41-46. https://doi.org/10.14169/j.cnki.zunyixuebao.2020.0011.
8. Yang, J., Liu, H, W., Yuan, L, P., et al. (2011) Establishment of Fresh Fruit Safety Production Management and Quality Traceability System [J]. Science and Technology of Food Industry, 32(5): 344-347. https://doi.org/10.13386/j.issn1002-0306.2011.05.076.
9. Xiao, F., Lai, T., Guan, Y, T., Hong, J, M., Zhang, H, L., Yang, G, Y., and Wang, Z, F. (2023) Application of Blockchain Sharding Technology in Chinese Medicine Traceability System, Cmc-Computers Materials & Continua, 76:35-48. https://doi.org/10.32604/cmc.2023.038937.
10. Jakkhupan, W., Arch-int, S., and Li, Y, F. (2015) An RFID-based traceability system A case study of rice supply chain, Telecommunication Systems, 58:243-58. https://doi.org/10.1007/s11235-014-9866-7.

11. Li, T., Wang, P., Yao, Z., et al. (2019) Research on the Application of Distributed Database Technology in Electric Power Enterprises [J]. Chinese Science Bulletin, 35(6):114-117. https://doi.org/ 10.13774/j.cnki.kjtb.2019.06.020.
12. Math, S., Tam, P., and Kim, .. (2021) Reliable Federated Learning Systems Based on Intelligent Resource Sharing Scheme for Big Data Internet of Things, Ieee Access, 9: 108091-100. https://doi.org/10.1109/ACCESS.2021.3101871.
13. Rong, G, P., Bai, X, Y., Yue, T. (2019) Foreword to the Special Topic of New Technologies in Software Engineering for DevOps [J]. Journal of Software, 30(10):3054-3055. https://doi.org/ 10.13328/j.cnki.jos.005798.
14. Zhan, Y. (2019) Big Data Application of Smart Tourism Destinations: Experience Upgrade and Service Upgrade [J]. Tourism Tribune, 34(8):6-8. https://doi.org/ 10.19765/j.cnki.1002-5006.2019.08.004.
15. Sarma, S, E., Weis, S, A., Engels, D, W. (2013) RFID Systems and Security and Privacy Implications[C]. Heidelberg: Springer Berlin Heidelberg, Berlin. https://www. Autoidcenter.org.
16. Alfian, G., Rhee, J., Ahn, H., et al. (2017) Integration of RFID, wireless sensor networks, and data mining in an e-pedigree food traceability system[J]. Journal of Food Engineering,212:65-75. https://doi.org/10.1016/j.jfoodeng.2017.05.008.
17. Yang, W, K. (2023) Analysis of the Application Prospect of Barcode Technology and RFID Technology in Logistics [J]. Science & Technology Information, 21(13):27-30. https://doi.org/10.16661/j.cnki.1672-3791.2211-5042-2111.
18. CAI, Y., LI, X., WANG, R., et al. (2016) Quality Traceability System of Traditional Chinese Medicine Based on Two Dimensional Barcode Using Mobile Intelligent Technology[J]. PLoSOne,11(10):e165263. https://doi.org/10.1371/journal.pone.0165263.
19. Wu, N., Li, Z., Barkaoui, K., et al. (2018) IoT-based smart and complex systems: a guest editorial report[J]. IEEE/CAA Journal of Automatica Sinica, 5(1):69-73. https://doi.org/ 10.1109/JAS.2017.7510748.
20. Xin, T, Y., Lei, M, Y., Song, J, Y. (2015) Research Progress on DNA Barcode Identification of Chinese Medicinal Materials [J]. Modern Chinese Medicine,17(2):170-176+184. https://doi.org/ 10.13313/j.issn.1673-4890.2015.2.020.
21. Yang, X, W. (2008) Fingerprint Study of Quality Evaluation of Traditional Chinese Medicine and Agricultural Development of Traditional Chinese Medicine [J]. JilinAgric.Sci, 30(4):127-135. https://doi.org/ 10.13327/j.jjlau.2008.04.045.
22. Gao, G, X., Dong, Z. (2010) Discussion on the Standardization of the Quality of Traditional Chinese Medicines and the Modernization and Development of Traditional Chinese Medicines [J]. Nei Mongol Journal of Traditional Chinese, 29(17):82-83. https://doi.org/10.16040/j.cnki.cn15-1101.2010.17.043.
23. Zheng, M. D., D. Liu, H. Zhang, and Y. Zhang. (2021) Molecular authentication of medicinal and edible plant Gnaphalium affine (cudweed herb, "Shu-qu-cao") based on DNA barcode marker ITS2, Acta Physiologiae Plantarum, 43. https://doi.org/ 10.1007/s11738-021-03293-3.
24. Li, Y, X., Yuan, W., Zhang, M. (2022) Problems and Countermeasures in the Supervision of the Quality and Safety of Edible Agricultural Products [J]. Modern Food Science and Technology, 28(22):133-135. https://doi.org/10.16736/j.cnki.cn41-1434/ts.2022.22.035.
25. Sun, J., Liu, J, N., Sun, Y, F., et al. (2019) Research progress of quality evaluation technology of Dendrobium species [J]. Food and Nutrition in China, 25(9):28-32. https://doi.org/10.19870/j.cnki.11-3716/ts.2019.09.007.

26. Zhang, T, J., Bai, G., Liu, C, X. (2019) The Concept, Core Theory and Research Methods of Quality Markers of Traditional Chinese Medicine[J]. Acta Pharmaceutica Sinica B. 54(02):187-196+186. https://doi.org/10.16438/j.0513-4870.2018-0912.
27. Chen, H, Q., Xu, D, Y. (2023) Practice and exploration of the traceability management model of "edible agricultural products commitment certificate + credit system" [J]. Chinese Agricultural Accounting, 33(02): 103-105. https://doi.org/10.13575/j.cnki.319.2023.02.039.