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A Study on the Development and Current Status of Curcuma wenyujin and Its Derivatives in the Context of Industrial Modernization: A Case Study of Rui'an City, Wenzhou

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Abstract

As one of the Eight Zhejiang Medicinal Materials, Curcuma wenyujin can be processed into three herbal variants from different medicinal parts. It contains abundant sesquiterpenes and monoterpenes, presenting anti-tumor, anti-inflammatory and antioxidant bioactivities. This study targeted the Curcuma wenyujin industry in Rui’ an, Wenzhou, to clarify its current development status and propose targeted improvements for production and sales. Taking local farmers, pharmaceutical enterprises and pharmacy practitioners as research objects, field visits, interviews and questionnaire surveys were applied for empirical analysis. The results indicated that local manufacturers mainly source raw materials from GAP bases to develop health and cosmetic products. However, the industry suffers from low public awareness, high market prices, limited mechanized production and low overall profits. This study identifies major industrial bottlenecks across planting, processing and marketing. It suggests integrating multi-stakeholder demands to stabilize medicinal quality, advance mechanization, strengthen popular science and optimize operational layouts, so as to elevate economic benefits and support the standardized, sustainable development of Curcuma wenyujin and its derivatives.

Keywords: Curcuma Wenyujin; Plant; Derivative Products; Practical Application

1. Introduction

Curcuma wenyujin is a renowned authentic medicinal herb from Rui’an City, Zhejiang Province, and is listed as one of the “Eight Zhejiang Herbs” (Li et al., 2023). Its rhizomes or tubers can be processed into three different types of traditional Chinese medicines through various

preparation methods: fresh rhizome slices are called “Pian Jianghuang,” boiled and sun-dried rhizomes are called “Wen’eshu,” and boiled and sun-dried tubers are called “Wenyujin” (Li et al., 2020). Wenyujin has the effects of clearing the heart and relieving depression, as well as removing blood stasis and alleviating pain; it is commonly used clinically to treat chest pain and angina pectoris, among other conditions (Zheng, 2019; Tao, 2015). Wen’eshu can promote the flow of qi and break up blood stasis; it is commonly used clinically in the treatment of early-stage cervical cancer (Commission, 2020). Pian Jianghuang can treat chest and abdominal distension and pain, as well as irregular menstruation (Editorial Committee of Flora of China, 1993). Derivatives of Curcuma wenyujin are also used in modern clinical practice; its essential oil is formulated into the proprietary Chinese medicine BaoFuKangShuan; and β-elemene, a component of the volatile oil, has been developed into an injectable solution and used as a non-cytotoxic anticancer drug (Li et al., 2023). Furthermore, a variety of marketed proprietary Chinese medicines with Curcuma wenyujin as a core ingredient are classified into four main categories according to their functions: blood-activating analgesic, liver-soothing and depression-relieving, mind-calming and brain-refreshing, and others. Representative products include Mai Luo Tong, a blood-activating analgesic commonly used for cardiovascular diseases; Jieyu Anshen Ke Li, a liver-soothing preparation widely applied in mood disorder treatment; and Angong Niuhuang Wan, a classic mind-calming emergency medicine for acute conditions. These products all have clear clinical positioning and quality standards based on the Chinese Pharmacopoeia.

Currently, some pharmaceutical companies in Ruian have begun processing and developing derivatives of Curcuma wenyujin; however, the variety of these derivatives remains limited, and their actual clinical applications are relatively restricted. Against the backdrop of industrial modernization, the industry faces the dilemma of products that are either “unusable” or “cannot be utilized.” Due to the combined influence of multiple factors, our team has launched a research study (Li, 2009) to explore pathways for the development of pharmaceutical derivatives. This study distinguishes itself from previous pharmacological research that focused solely on drug mechanisms; instead, it adopts a full industrial chain perspective. Given these challenges, Ruian, as the geo-authentic production area of Curcuma wenyujin with a centuries-long cultivation history, serves as an ideal typical case. It not only possesses a foundational industrial chain but also reflects the typical bottlenecks in the modernization of traditional Chinese medicine industries. Therefore, our team conducted a comprehensive analysis of the Rui’an Curcuma wenyujin product chain based on previous studies (Li, 2009), aiming to explore feasible approaches for the high value-added development of medicinal derivatives and to address the existing gaps in the industry.

2. Methodology

2.1. Study Design and Period

This study employed a cross-sectional mixed-methods design, combining quantitative surveys with qualitative field interviews. The research was conducted from July 2024 to September 2024 in Rui’an City, Wenzhou, Zhejiang Province, a nationally recognized production area of Curcuma wenyujin.

2.2. Participant Groups and Sampling

Four independent stakeholder groups were targeted:

Farmers (Group 1): Convenience sample of 68 individuals engaged in or familiar with Curcuma wenyujin cultivation.

Pharmaceutical enterprises (Group 2): 36 companies involved in the R&D, production, or sale of Curcuma wenyujin derivatives. These enterprises were located primarily in Rui'an City and surrounding areas of Wenzhou, and included traditional Chinese medicine manufacturers, health supplement producers, and cosmetic companies that either process Curcuma wenyujin or develop its derivative products.

Clinical practitioners (Group 3): 45 physicians with experience in Chinese herbal medicine.

Pharmacy staff (Group 4): 50 pharmacy workers in Rui'an.

2.3. Questionnaire Development and Validation

The enterprise questionnaire was specifically designed to investigate the development intentions and current practices of pharmaceutical companies regarding Curcuma wenyujin derivatives. A total of 50 questionnaires were distributed to eligible companies. The sample size of 50 was determined based on a convenience sampling strategy targeting all known enterprises in the Wenzhou region engaged in TCM processing or herbal product development. The questionnaire consisted of three sections: (1) procurement channels (single choice), (2) directions for derivative product development (multiple choice allowed), and (3) outlook and R&D focus (single choice with Likert scale).

Distribution was conducted through two channels: (a) electronic links sent via WeChat and email to company managers or R&D directors, and (b) on-site paper questionnaires during field visits. A total of 36 valid responses were collected (response rate 72%), which served as the basis for all enterprise-related analyses in this study. The discrepancy between 50 distributed and 36 valid responses is due to incomplete responses or non-participation from companies that were initially contacted but did not complete the survey.

The questionnaires distributed to farmers and sales channels (including pharmacies and hospitals) were designed around four core dimensions.: (1) background and practices (e.g., cultivation years, procurement channels, clinical experience);(2) perceived difficulties and barriers;(3) awareness of policies and market conditions;(4) expectations for government support and industrial development. Conduct a pre-network survey before the on-site investigation and organize experts to review and revise the relevant questionnaires.

Key items included the following examples:

For farmers: "What is the most critical factor affecting yield and quality?" (single choice);For enterprises: "What is your outlook for Curcuma wenyujin derivatives?" (5-point Likert scale: 1=very poor, 2=poor, 3=fair, 4=good, 5=very good);For clinicians: "How familiar are you with Curcuma wenyujin?" (5-point scale: 1=completely unfamiliar, 5=very familiar);For pharmacy staff: "How often does your institution sell Curcuma wenyujin products?" (5-point scale: 1=never, 5=very frequently).

All Likert-scale responses were analyzed using frequencies and percentages. The 5-point scale was treated as ordinal; central tendencies (mode, median) were examined.

2.4. Data Collection and Analysis

The questionnaire survey was conducted through the mobile platform (WeChat, direct link) for direct statistics to ensure the authenticity and comprehensiveness of the data. Descriptive statistics (frequencies, percentages) were calculated.

3. A Comprehensive Analysis of the Current Status of Curcuma wenyujin and Its Related Derivatives Development in the Context of Industrial Modernization

3.1. Pharmaceutical Companies Perspective

3.1.1. The Source of the Industrial Chain and Processing

Of the 36 surveyed enterprises, 16 provided valid responses regarding pharmaceutical companies' procurement channels for Curcuma wenyujin, nearly 100% of the samples indicated that they sourced the herb from the Standardized Cultivation Base of Curcuma wenyujin under Good Agricultural Practice (GAP), while purchases from small-scale farmers and company-owned cultivation bases accounted for a relatively low proportion. In addition, 22.2% (n=8) also purchased from small-scale farmers, and 16.7% (n=6) used company-owned cultivation bases. According to the team's field research and relevant literature (Li, 2009) cultivation bases typically possess large-scale, specialized planting techniques and management expertise. They can provide stable yields and consistent quality that meet pharmaceutical companies' requirements, while also driving the modernization and standardization of the Curcuma wenyujin industry, further expanding the industrial chain, and enhancing the competitiveness and added value of the entire sector.

Among the 36 surveyed enterprises, the majority chose to develop pharmaceuticals (75.0%, n=27) and health supplements (58.3%, n=21). Additionally, 47.2% (n=17) had invested in the development of cosmetics, and 13.9% (n=5) in food products. Nearly 41.7% (n=15) of enterprises indicated that further extraction of active ingredients for anticancer drugs and volatile oils is currently a major R&D focus (Liu et al., 2021). During the interview, the relevant staff members of the pharmaceutical company stated that they are actively engaged in technological research and development as well as brand building, and are promoting the iteration and innovation of derivative products.

3.1.2. Standardization of Product Manufacturing

Field visits revealed that among the 36 surveyed enterprises， most enterprises producing Curcuma wenyujin employ relatively outdated production techniques, rely on obsolete processing equipment (83.3%, n=30), and lack advanced production facilities and technical support. A comparison with the National Medical Products Administration's *Good Manufacturing Practice for Chinese Herbal Medicines (Reform)* reveals that the actual processing of Curcuma wenyujin involves lax quality control, inconsistent standards, and variable product quality. The active ingredient content and purity of products from different batches may vary significantly, which

directly affects clinical efficacy. Furthermore, the active ingredients in Curcuma wenyujin and its derivative products may degrade during storage and use. On-site visits revealed that the vast majority of primary processing plants do not have dedicated storage facilities for medicinal materials, resulting in insufficient stability of pharmacological efficacy.

3.1.3. Industry Outlook and Industrialization Process

In a survey of pharmaceutical companies regarding their outlook for Curcuma wenyujin-derived products, 58.3% (n=21) of respondents indicated a "good" outlook, while 33.3% (n=12) indicated a "very good" outlook. Subgroup analysis revealed that companies already developing health supplements were significantly more optimistic： 90.5% (n=19) rated the outlook as "very good" or "good," compared to 73.3% (n=11) among companies focusing solely on pharmaceuticals without health supplement involvement (n=15). The staff members of the pharmaceutical company mentioned in the interview that the company is actively seeking to establish partnerships with upstream and downstream enterprises in order to accelerate the industrialization process.

3.2. Market Perspective

This section examines the primary demands on the demand side by focusing on the two main market participants.

3.2.1. Current Demand Situation in Pharmacies

At the pharmacy level, patient demand for Curcuma wenyujin and its derivative medications is generally low (Figure 1). A field survey covering 32 pharmacy outlets in Rui'an City with 50 staff respondents revealed that more than half of the pharmacies scored 3 ("average") or lower, indicating that overall market demand is low. The survey data indicates that the use or sale of Curcuma wenyujin or its derivative products in the respondents' institutions is mostly occasional or infrequent, accounting for one-third of the total sample. Only 22% (n=11) of respondents reported that their institutions frequently use or sell such products. Interviews with survey participants revealed that smaller pharmacies generally do not stock Curcuma wenyujin-based proprietary Chinese medicines, primarily due to their relatively high cost. The survey results indicate that, in the pharmacy market context, Curcuma wenyujin and its derivative products are primarily used as medications, while awareness and acceptance of health products derived from it are relatively low. Furthermore, 74% (n=37) of pharmacy staff reported having received no professional training on Curcuma wenyujin or its related pharmaceutical products, and their understanding of the efficacy and target demographics for Curcuma wenyujin-containing proprietary Chinese medicines and health supplements ranged from general to limited. Correspondingly, customer awareness of Curcuma wenyujin is also low.

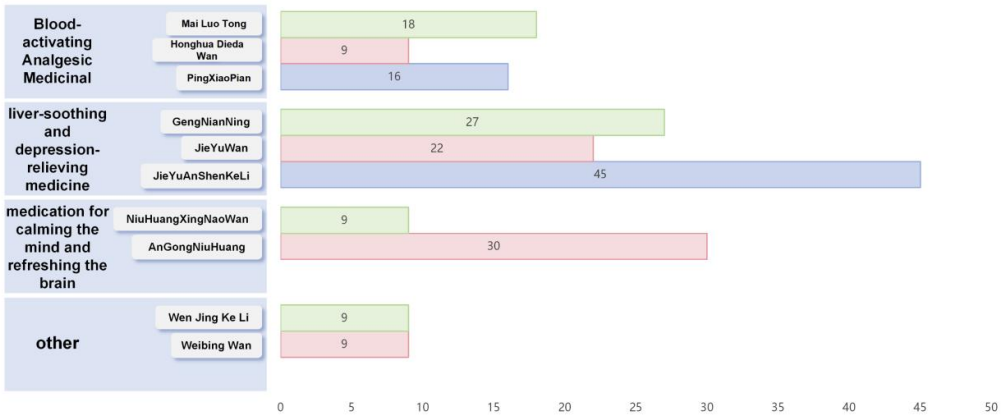

Figure 1. Commonly seen Chinese patent medicines containing Curcuma wenyujin and its extracts in the market.（Notes: Multiple-choice statistics results）

3.2.2. Current Status of Clinical Demand

In a survey regarding the clinical application of Curcuma wenyujin and its derivatives, 60% (n=27) of the responding physicians had been engaged in clinical practice for more than five years, and 68.9% (n=31) of them were familiar with Curcuma wenyujin and its derivative medications. Field visits revealed that in current clinical practice, Curcuma wenyujin extracts are commonly formulated into dosage forms such as tablets, microcapsules, and microspheres. Additionally, various Curcuma wenyujin extracts have been shown to reverse multidrug resistance in tumors. Related derivative products include Curcuma zedoaria oil injection and linalool emulsion injection; however, drugs targeting antitumor applications are still in the research and development trial phase (Wang, 2025). At present, Curcuma wenyujin and its derivatives still face challenges in clinical settings, including a limited variety of available formulations and relatively high drug prices. Given that nearly 70% of clinicians believe Curcuma wenyujin and its derivatives offer clear advantages (Figure 2)—namely, proven efficacy and minimal side effects—further development and application of these products are essential.

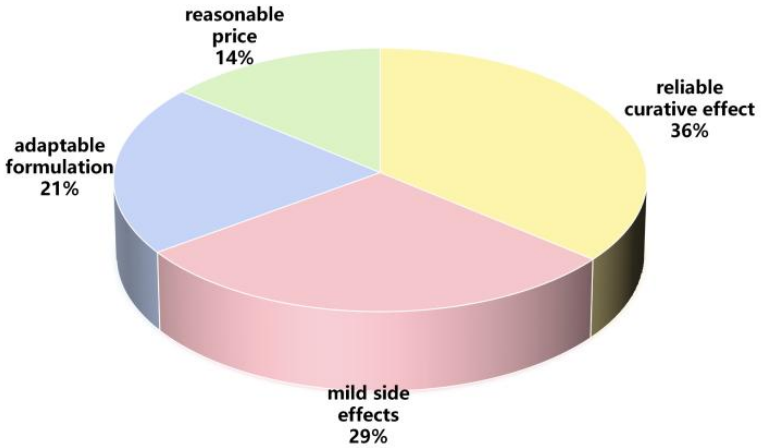

Figure 2. Advantages of Curcuma wenyujin extract as perceived by clinical practitioners.

（Notes: Multiple-choice statistics results）

3.3. Raw Material Suppliers Perspective

3.3.1. Low Mechanization Rate

Among the 68 surveyed farmers, 66.2% (n=45) identified “insufficient technological innovation and low production efficiency” as the primary constraint. Specifically, 50% (n=34) considered soil conditions the most critical factor affecting yield and quality, while only 12% (n=8) reported using mechanized irrigation or fertilization. Currently, small-scale farmers generally rely on traditional farming methods, while some large-scale agricultural operators have adopted water-saving irrigation technologies such as drip irrigation and micro-sprinklers, as well as biological control methods. Among the farmers surveyed, half believe that soil conditions are the most critical factor affecting the yield and quality of turmeric production, while mechanized water-saving irrigation and fertilization methods can effectively prevent soil structure degradation, such as soil compaction.

3.3.2. Degradation of Genetic Resources and Rampant Diseases

Field visits revealed that long-term self-seeding and the use of small seed lots have led to poor plant growth and frequent cases of premature aging in turmeric. Among the 48 farmers with cultivation experience, 45.8% (n=22) reported frequent premature aging, and 37.5% (n=18) reported severe bacterial wilt or pest problems. Long-term self- seeding was practiced by 79.2% (n=38) of experienced farmers, contributing to genetic degradation. At the same time, the vast majority of farmers mentioned during the interviews that the rampant spread of diseases such as bacterial wilt was an important factor affecting the yield of Curcuma wenyujin.

4. An Examination of Issues in the Development of Curcuma wenyujin and Its Derivatives Against the Background of Industrial Modernization

4.1. Constraints at the Source

From the perspective of raw materials (Wang, 2025), mechanical mechanization rates among individual farmers are low, and production operations are generally labor-intensive (Chen, 2024). Although some large-scale growers have experimented with water-saving irrigation technologies such as drip irrigation and micro-sprinklers, there remains an overall lack of suitable mechanized equipment. This makes it difficult to effectively prevent structural damage—such as soil compaction—caused by traditional farming methods (Zhang & Huang, 2025); At the same time, the degradation of germplasm resources and the rampant spread of diseases are severe. Long-term self-saving of seeds has led to frequent genetic degradation and premature plant senescence, while soil-borne diseases such as bacterial wilt continue to pose an escalating threat, directly limiting the stability of yields and the quality of medicinal materials at the source.

4.2. Production Shortcomings

In terms of production, processing technologies are relatively outdated. Most enterprises have outdated equipment and lack advanced technical support (Xiong et al., 2022), resulting in lax quality control and inconsistent adherence to standards during the production of Curcuma

wenyujin derivatives. This leads to significant variations in the content and purity of active ingredients across different batches, directly affecting the reliability of clinical efficacy; Furthermore, storage conditions are generally inadequate; the vast majority of primary processing plants lack dedicated storage facilities for medicinal materials. This makes active ingredients prone to degradation during storage, making it difficult to ensure the stability of medicinal efficacy and further exacerbating the instability of medicinal material quality.

4.3. Market Challenges

The shortcomings in the aforementioned stages ultimately trickle down to the retail level (Xue & Ding, 2024): demand at pharmacies is sluggish; smaller pharmacies generally do not stock the product due to its high cost; staff lack targeted professional training; and customer awareness of Curcuma wenyujin is generally low, leading to the product's gradual marginalization. At the clinical level, while its advantages—such as proven efficacy and minimal side effects—are widely recognized, the currently available range of traditional Chinese patent medicines is limited and prices are relatively high. Furthermore, cutting-edge drugs for treating cancer and other conditions are still in the research and trial stages. Consequently, the potential market value of Curcuma wenyujin—which has been widely used in clinical settings and received considerable acclaim—remains largely untapped (Zhang & Li, 2018).

5. Strategies for Enhancing the Development of Curcuma wenyujin and Its Derivatives in the Context of Industrial Modernization

Based on field research and existing literature, this paper proposes the following development strategies for the challenges faced by the Curcuma wenyujin in Rui'an(Figure 3).

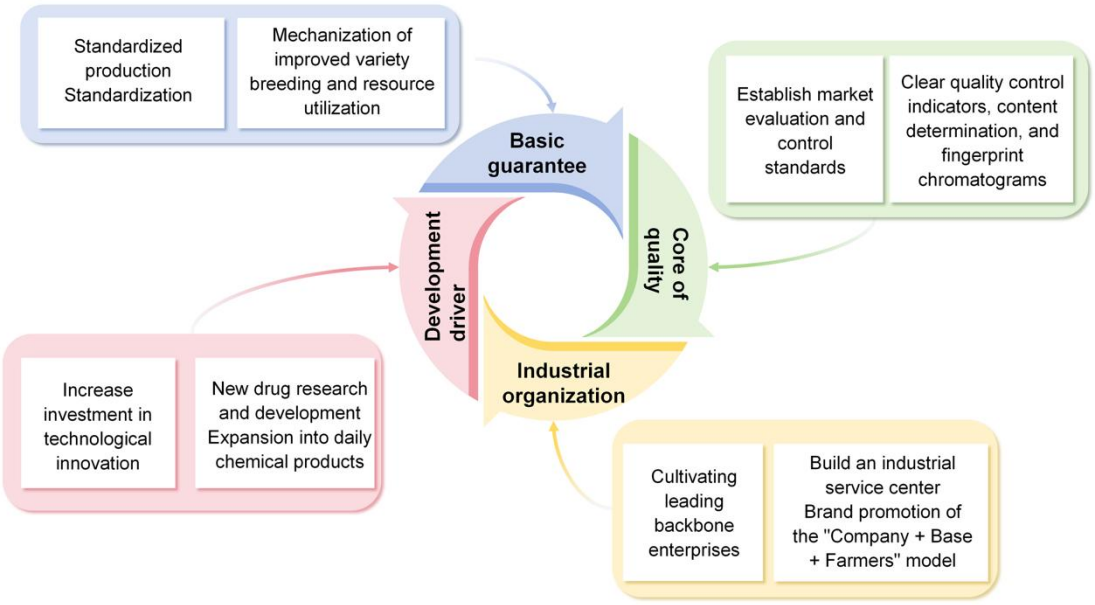

Figure 3. Schematic Diagram of the Enhancement Path for the Development of Curcuma wenyujin and Its Related Derivative Products.

5.1. Standardization and Regulation of Production

To better ensure the consistent quality of Curcuma wenyujin and guarantee medication safety, the standardization and regulation of its production are of urgent importance (Zheng, 2019).

5.1.1. Improving Breeding Methods

Curcuma wenyujin produces few flowers, and its seeds are numerous but underdeveloped; consequently, cultivation relies on propagating with ginger rhizomes (Guo et al., 2021), making it difficult to induce genetic variation for superior traits (Li et al., 2020; Li et al., 2023) applied virus-free seedling hardening and transplanting techniques to Curcuma wenyujin cultivation, overcoming the limitations of current seed selection and retention based solely on individual experience, and significantly improving both the yield and quality of Curcuma wenyujin. Therefore, establishing standardized high-quality seedling propagation bases, organizing technical training for farmers on seed selection, and promoting the industrial-scale propagation of tissue-cultured Curcuma wenyujin seedlings through the establishment of an in vitro rapid propagation system (Zheng, 2019) can provide a large supply of high-quality seed rhizomes for cultivation in the production area.

5.1.2. Enhancing Production Mechanization

Although research and development of harvesting machinery for Curcuma wenyujin has been underway in recent years, existing machinery causes significant damage to the crop, preventing the efficient utilization of the entire plant—particularly the tuberous roots used for medicinal purposes. Therefore, it is crucial to strengthen scientific research and increase financial investment to develop integrated mechanized technologies and equipment suitable for the production and primary processing of Curcuma wenyujin (Guo et al., 2021), thereby mechanizing field production and ensuring scientific post-harvest processing. Promoting smart greenhouse cultivation technology for Curcuma wenyujin (Guo et al., 2021), through crop condition and environmental monitoring as well as crop trait monitoring, enables intelligent production control and remote monitoring, thereby achieving precision production and smart management, particularly to avoid soil compaction caused by excessive fertilization as much as possible. To stabilize the production quality of Curcuma wenyujin, Guan Yanhui et al. analyzed soil microbial populations and concluded that fumigation treatment can significantly alleviate the problems associated with continuous cropping of Curcuma wenyujin (Su, 1994) . Developing fumigation techniques and implementing appropriate crop rotation for Curcuma wenyujin are key strategies for reducing the accumulation of harmful soil microorganisms and enhancing the quality of the entire Curcuma wenyujin plant as a medicinal herb. Strengthening the integration of internet information technology, advanced agricultural technologies, and crop cultivation, and establishing GAP systems to enable comprehensive intelligent tracking of Curcuma wenyujin growth, while ensuring healthy growth through monitoring, irrigation, and temperature control.

In terms of product processing, given the current issue of large quantities of discarded Curcuma wenyujin plants being left unused during the production and development of Curcuma wenyujin and its derivative products, pharmaceutical companies and research institutions should pay greater attention to the reprocessing and utilization of these discarded plants. Resource recovery and safe

disposal should be achieved through technologies such as bioconversion, chemical conversion, and physical conversion (Zhu & Li, 2026). Develop resource-based products such as functional foods, feed additives, and functional personal care products to extend the resource value chain, increase the utilization of the entire Curcuma wenyujin plant. At the same time, increase investment in the construction of storage facilities for Curcuma wenyujin medicinal materials, strictly enforce quality control management during the production and processing of Curcuma wenyujin plants, and strengthen testing of active ingredient content in Curcuma wenyujin products to ensure the consistent efficacy of Curcuma wenyujin medicinal materials and their derivatives.

5.2. Establishing Market Quality Control Standards

Currently, the quality of Curcuma wenyujin on the market varies widely, a situation closely related to the lack of established quality control indicators and the overlap between the herbal name and the botanical name (Ren et al., 2017). Research on the quality evaluation and control of warm curcuma is currently limited. The 2025 edition of the *Pharmacopoeia of the People's Republic of China* only includes moisture and ash content as quality control standards, along with thin-layer chromatography identification methods; it does not provide explicit regulations regarding the determination of chemical constituents or fingerprint profiles for Curcuma wenyujin. According to literature reports, the primary active components in Curcuma wenyujin are curcumin and volatile oil components, which can serve as the preferred quality markers for the traditional Chinese medicine Curcuma . Therefore, further analytical research on its volatile oil components is warranted to establish quality testing standards for authentic Curcuma wenyujin, thereby providing a scientific basis for the standardized and large-scale production of Curcuma wenyujin (Li et al., 2020; Liu et al., 2023).

5.3. Ultivating Leading Enterprises

The brand development and industrialization levels of the authentic Curcuma wenyujin medicinal herb base remain low, with a lack of strong leading enterprises and weak capabilities in new product R&D and brand protection. It is therefore crucial to cultivate leading enterprises to take the lead, with the local government providing guidance and supervision, in establishing a “China Curcuma wenyujin Industry Service Center” that integrates origin trading, warehousing, primary and secondary processing, scientific and technological services, production and sales information, entity cultivation, and brand protection. At the same time, following the “company (professional cooperative) + base + farmer” business model, we should leverage the advantages of “Internet + Traditional Chinese Medicine”, explore the historical origins of Rui’an’s authentic Curcuma wenyujin, and strengthen brand creation, protection, and promotion (Zhang & Gao, 2023).

We should accelerate the “matching” of cultivation bases with pharmaceutical companies and research institutions. By facilitating direct connections between farmers, pharmaceutical firms, and research bases, we can reduce the instability caused by imbalances in the supply and demand of medicinal materials. Through personalized customization and rapid, feedback-driven improvements in production methods, we can swiftly enhance production efficiency and stabilize

the quality of medicinal materials. At the same time, given the high cost and low public awareness of Curcuma wenyujin and its derivative medicines mentioned above, pharmaceutical companies should also intensify promotional efforts, advance training for grassroots market personnel, and popularize the efficacy and applications of Curcuma wenyujin and its derivative products.

5.4. Increasing Investment in Scientific and Technological Innovation

As research into the chemical composition and pharmacological effects of Curcuma wenyujin continues to deepen, it is playing an increasingly important role in the pharmaceutical field. Pharmaceutical companies should actively seek partnerships with universities and research institutes to continuously strengthen research into the mechanisms of action of Curcuma wenyujin and explore new pathways for drug targeting. This will enable the continuous development of new applications for Curcuma wenyujin and the creation of derivative products with superior efficacy. In new drug R&D, modern technological methods should be actively utilized to accurately identify market needs in cancer treatment (He, 2025). Extraction efficiency of active ingredients in Curcuma wenyujin should be improved through optimized extraction methods, and the degradation rate of active ingredients should be reduced through formulation modifications. Concurrently, the development and application of clinically proven active ingredients—such as olibanene and tetrahydrocurcumin—in new anti-cancer drugs both domestically and internationally should be accelerated. Through clinical trials and efficacy evaluations, the rapid production and market launch of new drugs should be facilitated to meet patient needs. In the development of daily chemical products, we will enhance the comprehensive utilization of the entire Curcuma wenyujin plant to develop a range of topical and daily chemical products.

6. Discussion

Through literature reviews, action research, surveys, and field interviews, combined with scientific data analysis, it is evident that an industrial chain for the development of Curcuma wenyujin and its related derivative products has begun to take shape.

In response to the industrialization shortcomings identified in existing literature on the standardized production and research progress of Curcuma wenyujin, as well as the practical development obstacles summarized from on-site visits, it is imperative to address issues such as mechanization coverage, specialized talent cultivation, and germplasm resource optimization at the source of the industrial chain. This should be coordinated with product R&D in the midstream of the industrial chain to drive industrial transformation and upgrading (Li et al., 2020; Liu et al., 2023). Furthermore, the downstream segment of the industry chain should focus on enhancing the professional competence of service sectors such as pharmacies to better meet patient demand for Curcuma wenyujin and its derivative products, thereby improving the efficiency and competitiveness of the entire Curcuma wenyujin industry chain.

This study focused primarily on Rui’an City in Wenzhou. While it provides a relatively accurate reflection of the actual conditions of the local Curcuma wenyujin industry, Rui’an, as a designated origin region, exhibits certain unique characteristics in terms of its industrial model

and policy environment; therefore, the applicability of the study's conclusions to other production areas requires further verification. Additionally, due to research constraints, the sample sizes at the pharmaceutical company and pharmacy levels were relatively limited. The statistical robustness of some quantitative analyses requires reinforcement through subsequent studies that expand the sample size. Regarding data collection, this study primarily relied on questionnaires and interviews. Some information was based on respondents' subjective judgments; although a five-point scale was used for quantification, it remains difficult to completely avoid potential biases arising from individual cognitive differences. Future research could incorporate cross-validation using objective indicators such as sales ledgers and prescription records. Furthermore, while this study focuses primarily on the cultivation, production, and sales stages, research on the needs, preferences, and medication experiences of end-users remains relatively limited. Direct data from the patient perspective still needs to be supplemented.

Future research could expand the scope of the study and increase the sample size, while also incorporating objective data sources, strengthening specialized surveys of patients, and employing longitudinal tracking to dynamically observe industry trends. This approach aims to provide more comprehensive decision-making guidance for the healthy development of the Curcuma wenyujin industry.

7.Conclusions

In summary, our research conducted a systematic summary of the current production status of Wen Yuning in Rui'an, Wenzhou. It proposed comprehensive solutions to the existing problems in the aspects of planting, production, and sales. At the same time, it also provided a new perspective for optimizing the industrial chain of other authentic medicinal herbs.

Author Contributions:

Conceptualization, H.C. and Y.J.; methodology, C.L.; software, X.L.; validation, H.C., Y.J. and Y.Z.; formal analysis, Y.J.; investigation, H.C., Y.Z. and C.L.; resources, Y.J.; data curation, H.C. and Y.J; writing—original draft preparation, C.L. and X.L; writing—review and editing, H.C. and Y.Z; visualization, Y.Z.; supervision, D.L.; project administration, D.L.; funding acquisition, D.L. All authors have read and agreed to the published version of the manuscript.

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Institutional Review Board Statement:

Ethical review and approval were waived for this study due to studies not involving humans or animals.

Informed Consent Statement:

Not applicable.

Data Availability Statement:

The data presented in this study are available on request from the corresponding author due to the presence of commercial secrets.

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Conflict of Interest:

The authors declare no conflict of interest.

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