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Research on the Development of the Biomedical Industry Driven by New Quality Productive Forces in Qingyuan City Guangdong Province

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ABSTRACT

This paper, guided by the theory of new quality productivity, systematically studies the current development status, driving mechanism and upgrading path of the biopharmaceutical industry in Qingyuan City, Guangdong Province. By sorting out the theoretical connotation of new quality productivity and the development characteristics of the biopharmaceutical industry, an analytical framework of "technological breakthrough - factor upgrading - industrial synergy - institutional innovation" is constructed. Combined with the industrial data, enterprise cases and policy documents of Qingyuan City, the internal logic of new quality productivity driving industrial development is revealed. The research finds that the biopharmaceutical industry in Qingyuan City has formed a spatial layout of "two zones, three counties and six parks", and has a certain foundation in the fields of anesthetic drugs, raw materials and southern medicine planting, but there are problems such as small industrial scale, insufficient innovation ability and shortage of high-end talents. Based on empirical analysis, this paper proposes measures such as strengthening the construction of scientific and technological innovation platforms, improving the industrial chain, optimizing the talent cultivation mechanism and deepening policy coordination to promote the transformation of the biopharmaceutical industry in Qingyuan City to high-quality development, providing practical references for the cultivation of strategic emerging industries in northern Guangdong.

Keywords: New Quality Productivity; Biopharmaceutical Industry; Innovation-Driven; Industrial Upgrading; Qingyuan City

Introduction

Research Background and Significance

Currently, the world is undergoing a new round of technological revolution and industrial transformation. New quality productivity, driven by scientific and technological innovation, has become the core force for promoting high-quality economic development. The Third Plenary Session of the 20th Central Committee of the Communist Party of China clearly pointed out that it is necessary to "improve the institutional mechanisms for developing new quality productivity in a way that suits local conditions, and promote revolutionary breakthroughs in technology, innovative allocation of production factors, and deep transformation and upgrading of industries." As an important component of strategic emerging industries, the biopharmaceutical industry is characterized by high technology, high investment, and high growth, and is a key area for developing new quality productivity. Guangdong Province, as a major biopharmaceutical province, achieved a revenue of 663.8 billion yuan in the biopharmaceutical and health industry cluster in 2023, and its medical device industry has ranked first in the country for many consecutive years. It is accelerating towards the goal of a trillion-yuan industry cluster. Qingyuan City, an important city in the northern ecological development zone of Guangdong Province, has included biopharmaceuticals in the "8+1" cluster for key cultivation. Relying on the spatial layout of "two zones, three counties, and six parks," it has formed an industrial system covering drug research and development, medical devices, and southern medicine planting.

In 2024, there were 9 large-scale pharmaceutical manufacturing enterprises in the city, with an industrial output value of 2.04 billion yuan. Key enterprises such as Jiabo Pharmaceutical have already achieved national competitiveness in the field of anesthetic drugs. However, compared with core cities in the Greater Bay Area such as Guangzhou and Shenzhen, Qingyuan faces prominent issues such as small industrial scale and insufficient innovation capabilities. Against this background, studying the path for new quality productivity to drive the development of the biopharmaceutical industry in Qingyuan is of significant theoretical and practical importance for promoting regional industrial transformation and upgrading and building a modern industrial system.

Literature Review

Research on New Quality Productivity Theory: Since its proposal, the concept of new quality productivity has become a hot topic in academic and policy research. Its core connotation is to take scientific and technological innovation as the main driving force, achieve revolutionary breakthroughs in technology, innovative allocation of production factors, and deep transformation and upgrading of industries, and form a high-tech, high-efficiency, and high-quality advanced productivity form. Different from the investment-driven model of traditional productivity, new quality productivity emphasizes the improvement of total factor productivity, which is reflected in the deep integration of the innovation chain and the industrial chain. In the biopharmaceutical field, the manifestations of new quality productivity include technological innovation applications such as artificial intelligence drug research and development, digital production, and green biomanufacturing, as well as systematic changes such as industry-university-research collaboration and talent factor upgrading.

Research on the Development of the Biopharmaceutical Industry: Domestic and foreign scholars generally believe that the development of the biopharmaceutical industry requires the construction of a full-chain ecosystem of "innovation - transformation - industrialization." Guangdong Province has promoted the optimization of the entire process from research and development to clinical application of innovative drugs and medical devices through measures such as strengthening "three-medical coordination," improving the review and approval mechanism, and establishing industrial investment funds. For latecomer regions, industrial upgrading faces challenges such as insufficient innovation resources and incomplete industrial chains. They need to rely on regional comparative advantages and explore differentiated development paths. Most of the research on Qingyuan City focuses on the development of southern medicine resources and the construction of industrial parks, but lacks systematic analysis from the perspective of new quality productivity theory.

Research Methods and Framework

This paper adopts a combination of qualitative and quantitative research methods: through literature research, it sorts out the theoretical connection between new quality productivity and the development of the biopharmaceutical industry; using statistical analysis methods, it analyzes the current development status and problems based on the industrial data of Qingyuan City from 2019 to 2024; it selects typical enterprises such as Jiabo Pharmaceutical and Haoruien Pharmaceutical to conduct case studies and summarize innovative practical experiences; and combines policy text analysis to propose targeted development suggestions. The research framework is divided into five parts: the theoretical basis section defines the core connotation of new quality productivity and its driving mechanism for the biopharmaceutical industry; the current situation analysis section elaborates on the scale, structure, and spatial layout of the biopharmaceutical industry in Qingyuan City; The problem diagnosis section identifies development bottlenecks from dimensions such as innovation capacity, factor allocation, and industrial synergy; the case study section analyzes the practice of cultivating new quality productivity at the enterprise level; the policy recommendation section builds a multi-dimensional support system.

The Theoretical Framework of New Quality Productivity Driving the Development of the Biopharmaceutical Industry

The Core Connotation and Characteristics of New Quality Productivity

New quality productivity is the innovative development of Marxist productivity theory in the new era. Its essence is the qualitative leap of advanced productivity, manifested in the systematic upgrade of laborers, means of labor, objects of labor, and their optimal combination. Compared with traditional productivity, new quality productivity has three significant features: first, innovation-driven, with revolutionary technological breakthroughs as the core driving force, and new technologies such as artificial intelligence and big data becoming important components of production factors; second, factor synergy, achieving an increase in total factor productivity through the innovative allocation of factors such as talent, capital, and technology; third, industrial disruption, giving rise to new business forms and models, and promoting the extension of the industrial value chain to the high end. In the biopharmaceutical field, the formation of new quality productivity is manifested as: the research and development model shifting from traditional experiment-driven to AI-assisted design, the production method upgrading from standardized manufacturing to intelligent customization, and the industrial form expanding from single pharmaceuticals to the integration of "pharmaceuticals + health". The goal of building a biomanufacturing industry innovation highland proposed by Guangdong Province is a concrete practice of new quality productivity in the biopharmaceutical field, with the plan to achieve a biomanufacturing output value of one trillion yuan by 2035.

The Cultivation Mechanism of New Quality Productivity in the Biopharmaceutical Industry

Technological Innovation-Driven Mechanism: Revolutionary technological breakthroughs are the core engine for the formation of new quality productivity in the biopharmaceutical industry. In the research and development stage, artificial intelligence accelerates the drug discovery process, reducing the traditional compound screening cycle from several years to several months; in the production stage, continuous production technology and digital workshops achieve precise control of drug quality; in the circulation stage, blockchain technology ensures the traceability of drugs throughout their life cycle. Qingyuan High-tech Zone provides phased subsidies for clinical research of innovative drugs, with a maximum of 30 million yuan in research support, precisely to encourage enterprises to carry out technological breakthroughs.

Mechanism of Optimizing Factor Allocation: New quality productivity emphasizes the innovative allocation of production factors. In terms of talent factors, a dual-track model of "high-end talent introduction + local talent cultivation" is formed. Qingyuan City provides 1 million yuan in incentive subsidies for major scientific and technological project teams in the biopharmaceutical field; in terms of capital factors, a financing and investment system of "government guidance funds + social capital" is constructed. Guangdong Province is studying the establishment of a biopharmaceutical industry investment guidance fund; in terms of data factors, efficient utilization of medical insurance data and clinical data is achieved through platforms such as "Medicine Connect".

Mechanism of Industrial Coordinated Development: Deep industrial coordination is an important path for the diffusion of new quality productivity. By building a collaborative network of "research institutions - production enterprises - medical institutions", Qingyuan City has gathered nearly 50 biopharmaceutical enterprises in the High-tech Zone, established one provincial-level new research institution and 16 engineering technology research centers, forming a spatial agglomeration effect of innovation resources. Guangfo Industrial Park promotes the integrated development of biological experiments, research, and manufacturing through the "industrial investment + enterprise incubation + resource sharing" model.

Mechanism of Institutional Innovation Guarantee: Institutional innovation guarantee is a key mechanism for the cultivation of new quality productivity. Through the establishment of a "one-stop" service system and the implementation of a "green channel" for project approval, the efficiency of project implementation is improved. Qingyuan High-tech Zone has established a "one-stop" service system and implemented a "green channel" for project approval, significantly improving the efficiency of project implementation. Guangdong Province is promoting the establishment of a biopharmaceutical industry innovation ecosystem, including the construction of a biopharmaceutical industry innovation center and the establishment of a biopharmaceutical industry innovation alliance. These measures aim to create a favorable institutional environment for the cultivation of new quality productivity in the biopharmaceutical industry. Innovation in systems provides environmental support for the development of new quality productive forces. Guangdong Province has optimized the approval process for clinical trials, deepened the "Hong Kong-Macao Medical Devices and Pharmaceuticals Access" policy, and improved the medical insurance payment mechanism, etc., to reduce the cost of the flow of innovative elements. The biomedical industry innovation policy implemented in Qingyuan City's high-tech zone provides full-chain support from new drug registration, medical device research and development to the construction of innovation platforms, forming a "policy package" of system innovation.

Analysis of the Current Development Situation of the Biomedical Industry in Qingyuan City

Industry Scale and Structural Characteristics

Steady Growth in Overall Scale: In recent years, the biomedical industry in Qingyuan City has shown a continuous development trend. In 2024, there were 9 state-owned pharmaceutical manufacturing enterprises in the city, with an industrial output value of 2.04 billion yuan, maintaining stable growth compared to the previous year. The backbone enterprise Jiaobo Pharmaceutical achieved a revenue of nearly 350 million yuan in 2024, with significant contributions from new products such as fluoribefenate injection, demonstrating good growth potential. In the field of traditional Chinese medicine, the planting area of Qingxin District and Liannan Yao Medicine Industrial Park reached 48,200 mu, and the comprehensive output value of South Medicine in Qingxin District reached 1.45 billion yuan in 2024, with an expected breakthrough of 2 billion yuan in 2025. From a longitudinal comparison, the biomedical industry in Qingyuan City is still in the cultivation stage. Based on the existing data, the average annual growth rate of the industry from 2019 to 2024 was approximately 8.5%, which was lower than the 13.7% average annual growth rate of the biomedical industry in Guangdong Province during the same period. In 2024, the output value of the pharmaceutical manufacturing industry in Qingyuan City accounted for only 0.96% of the city's GDP, far below the provincial average, and the contribution of the industry needs to be improved.

Initial Appearance of Specialized Fields: The biomedical industry in Qingyuan City has formed several specialized fields: In the field of chemical drugs, Jiaobo Pharmaceutical's propofol emulsion injection, as the national quality standard setter, occupies an important market share in China and has passed the EU EMA certification; in the field of medical devices, 8 new medical device manufacturing enterprises were added in 2024, mainly concentrated in medical consumables fields; in the field of traditional Chinese medicine, 57 South medicine varieties such as garma and yudzi have formed large-scale cultivation, providing raw material support for the processing of Chinese herbal medicine decoctions; in the field of animal health care,

relying on the breeding foundation of Qingyuan chickens and pigs, a characteristic chain of veterinary drug production and breeding services has been formed.

Gradient Characteristics of Enterprise Structure: The biomedical enterprises in Qingyuan City present a pattern of "leadership by leading enterprises + clustering of small and medium-sized enterprises". As of 2024, there is 1 national specialized and innovative "little giant" enterprise (Jiaobo Pharmaceutical) in the city, and several provincial specialized and innovative enterprises, forming a gradient development trend. From the perspective of enterprise scale, most enterprises are still in the small and medium-sized stage, with the number of state-owned enterprises accounting for only 1.36% of Guangzhou and 1.88% of Shenzhen. There are no large Leading enterprises leading the industry development. From the ownership structure perspective, the proportion of foreign-funded enterprises is low, with actual foreign investment of 1.038 billion yuan in 2024, a year-on-year decrease of 10.1%, and the outward-oriented economic characteristics are not obvious.

Spatial Layout and Agglomeration Trend

Spatial Architecture of "Two Zones, Three Counties, Six Parks": Qingyuan City has constructed a biomedical industry spatial layout of "Two Zones; Three Counties; Six Parks". Qingyuan High-tech Zone, as the core cluster area, focuses on developing drug research and development, stem cell technology, etc., with nearly 50 enterprises clustered and 1 provincial new type research and development institution and 16 engineering technology research centers. The Guangfo (Fogang) Industrial Park, relying on the Guangdong-Fujian (Fogang) Life Science Park project, focuses on high-end biomedical and medical devices, plans to build a bioresearch, development, and manufacturing integrated park, and has introduced 6 proposed-signed enterprises. At the county level, the South Medicine Industrial Park in Qingxin District and the Liannan Yao Medicine Industrial Park have formed a base for Chinese herbal medicines cultivation and processing; Yingde and Lianzhou have developed characteristic medicinal resource development. This layout not only leverages the innovation factor concentration advantage of the central urban area, but also makes use of the ecological resource endowment of the county, forming a gradient development pattern.

Construction Effect of Industrial Parks: The Qingyuan High-tech Zone has promoted industrial agglomeration through policy innovation. It has issued the "Several Measures for Promoting the Innovative Development of Biomedical Industry", providing a maximum subsidy of 50 million yuan for new drug clinical research and medical device development. The Guang-Fo Industrial Park signed and put into production 20 projects in the third quarter of 2024, with a total investment of 2.47 billion yuan, and an estimated output value of 5.416 billion yuan. The annual industrial output value reached 1 billion yuan, with a year-on-year growth of 70%. The Huacun Zhihui Gu Valley project, as a specialized biomedical park, has a total investment of 600 million yuan and plans to introduce over 30 manufacturing enterprises, with an expected contribution of over 3 billion yuan in output value. The agglomeration effect of the park has initially emerged, but compared with Guangzhou International Biomedical Island and Shenzhen Pingshan National Biobased Industrial Base, the enterprise density, investment intensity and output efficiency of the Qingyuan park still have a large gap. In 2024, the investment intensity per square kilometer of land in the Guang-Fo Industrial Park was approximately 280 million yuan, only about 1/5 of that of Guangzhou Science City.

Innovation Capacity and Factor Allocation

Research and Development Investment and Transformation of Achievements: Biomedical enterprises in Qingyuan gradually increase their research and development investment. Jiaobo Pharmaceutical has received over 36 million yuan in various levels of government scientific and technological innovation funds in the past three years and has established an innovation matrix covering seven technical modules. In terms of patent output, Qingyuan Hospital of Traditional Chinese Medicine applied for patents such as anti-Helicobacter pylori traditional Chinese medicine paste formula in 2024, and the South China Normal University (Qingyuan) Science and Technology Innovation Research Institute developed a technology for anti-Helicobacter pylori using blood-transporting vegetable extract. However, from an overall perspective, the number of patents in the biomedical field of the city is relatively small. In 2023, the main biomedical patents in Guangdong Province were concentrated in Guangzhou (18,196) and Shenzhen (11,155), and Qingyuan has not yet entered the statistical scope.

Talent Structure and Cultivation Mechanism: The talent team of Qingyuan's biomedical industry presents the characteristics of "insufficient total quantity and unbalanced structure". Jiaobo Pharmaceutical has 53 research and development personnel, accounting for 11.13% of the company's total personnel. The demand for master's degrees in the biomedical industry of the city accounts for only 3.659%, far lower than the 24% level of similar enterprises in Suzhou. To solve the talent bottleneck, Qingyuan has introduced incentive measures, providing 1 million yuan as a subsidy for teams participating in major scientific and technological projects and 300,000 yuan as a reward for technology transfer teams. However, the introduction and cultivation of high-end talents still face a geographical disadvantage and are difficult to compete with core cities in the Greater Bay Area.

Policy Support and Service System: Qingyuan has constructed a multi-level policy support system: at the municipal level, biomedicine is included in the "8+1" industrial cluster cultivation plan; at the high-tech zone level, special subsidies for new drug research and development and medical devices are implemented; at the park level,

the Guang-Fo Industrial Park has issued "Eight Policies for Promoting High-Quality Economic Development", covering enterprise relocation, technological transformation investment, and talent rewards, etc. In terms of medical insurance service innovation, after the "Medicine and Health" platform was launched, 15 pharmacies have provided electronic prescription circulation services for "dual channels" drugs, and the medical insurance fund has paid 27.7775 million yuan.

Bottlenecks in Industrial Development Driven by New Quality Production Capacity

Insufficient Innovation-Driven Capacity

Low Investment in Research and Development Intensity: The investment in research and development of the biomedical industry in Qingyuan is insufficient. In 2024, the total scientific and technological expenditure in the city was 285million yuan, accounting for only 0.66% of the local general public budget expenditure. At the enterprise level, except for a few backbone enterprises such as Jiaobo Pharmaceutical, most small and medium-sized enterprises have weak R&D capabilities and lack a continuous investment mechanism. Compared with the average R&D investment ratio of 5.8% in the Guangdong biomedical industry, Qingyuan is estimated to be less than 3%, which is difficult to support core technology breakthroughs. Insufficient investment in research and development has led to a lack of innovative achievements. There is no 1st-class innovative drug approved in the city, which contrasts sharply with the 75 clinical trial approvals granted in Guangzhou in the first half of 2024.

Weak Support from Innovation Platforms: The number of biomedical innovation platforms in Qingyuan is small and their level is low. There is only 1 provincial-level new research and development institution and 16 engineering technology research centers. There are no high-end platforms such as national key laboratories or clinical medical research centers. Compared with the national-level platforms such as Zhong Nanshan Laboratory gathered in Guangzhou International Bio-Island, Qingyuan has obvious shortcomings in basic research and pilot-scale incubation. The insufficient innovation platforms prevent the smooth collaboration between industry, academia and research, and the research achievements of institutions such as Qingyuan Hospital of Traditional Chinese Medicine cannot be quickly transformed. The low industrialization rate of technological achievements of the Guangdong Normal University (Qingyuan) Innovation Research Institute is also a result of the insufficient innovation platforms.

Lagging Digital Transformation: The digital and intelligent level of the biomedical industry is an important indicator of new quality productive forces. However, the digital transformation process of enterprises in Qingyuan is slow. Although Haoruien Pharmaceutical has achieved automation in some production processes, it is still at the "mechanization + automation" stage and has not formed a full-process digital control. Compared with the "black light factory" of Shenzhen Meirui Medical and the digital twin park of Guangzhou International Bio-Island, Qingyuan has significant gaps in intelligent manufacturing and digital research and development fields. It fails to fully leverage the role of digital technology in improving production efficiency.

Imbalance in the Allocation of Industrial Elements

Shortage of High-End Talent Supply: There is a "three-deficit" phenomenon in the biomedical talent pool of Qingyuan: there is a lack of leading talents, and there are no national talent program winners; there is a lack of high-end R&D talents, with the proportion of master's degree and above talents being only 3.659%; there is a lack of skilled talents, and there are insufficient technical workers in pharmaceutical manufacturing. The talent shortage limits the innovation capabilities of enterprises. The R&D team of Jiaobo Pharmaceutical has only 53 people and is unable to undertake multiple innovation tasks. The geographical disadvantage exacerbates the talent predicament. The attractiveness of Qingyuan to high-end talents is much lower than that of Guangzhou and Shenzhen. The number of recruitment positions in the biomedical industry in 2024 only accounts for 0.243% of the city's total. The contradiction between supply and demand of talents is prominent.

Inefficient Allocation of Capital Elements: The biomedical industry has high risks and long cycles and requires diversified capital support. However, the financing channels in Qingyuan are single. The scale of government-guided funds is small, and no specialized biomedical industry investment fund has been established; the participation of social capital is low. In 2024, the investment and financing amount in the biomedical field in the city did not enter the provincial statistics and was far lower than the cumulative scale of 42.313 billion yuan in Guangzhou and 86.338 billion yuan in Shenzhen. The difficulty in financing restricts the development of enterprises. Haoruien Pharmaceutical faces financial pressure during expansion and small innovation enterprises are more likely to face the "death valley" predicament.

Inadequate Utilization of Land Elements: The level of intensive utilization of industrial park land in Qingyuan is not high. The Guangfo Industrial Park has cumulatively signed 148 projects with a total investment of over 28 billion yuan, but only achieved an industrial output value of 860 million yuan in 2024-11. The investment-output efficiency is low. Some parks have a phenomenon of "emphasizing signing but neglecting construction", and 6 project plots of Xiangxue and Bendi are idle, failing to form effective production capacity. The mismatch of land elements leads to a lack of space carriers for the cultivation of new quality productive forces and makes it difficult to form an industrial cluster effect.

Imperfect Industrial Ecosystem

Incomplete Industrial Chain: The biomedical industry chain in Qingyuan has "broken links" and "weak links" problems: there is a

lack of key raw material and drug excipient production enterprises in the upstream; the midstream formulation production capacity is weak, except for anesthetic drugs, there are no advantageous varieties; the downstream lacks contract research organizations (CRO) and contract manufacturing organizations (CMO) and other professional service institutions. The incomplete industrial chain leads to increased production costs for enterprises, reduced innovation efficiency, and makes it difficult to form a collaborative development pattern.

Inadequate Regional Collaboration Mechanism: Qingyuan failed to fully integrate into the biopharmaceutical industry collaboration network of the Greater Bay Area, and there was poor coordination in the connection of innovation resources with Guangzhou and Shenzhen. Although the Guangfo Industrial Park was developed by the Guangzhou Development Zone, there was insufficient collaboration in terms of innovation resource sharing and joint talent training. Compared with the scale of 120 enterprises in the Hengqin Guangdong-Macao Cooperation Traditional Chinese Medicine Science and Technology Industrial Park, Qingyuan's benefits from regional collaboration were limited, and it was unable to effectively absorb the industrial spillover from core cities.

Insufficient Policy Synergy: Although several supporting policies were introduced, there was insufficient policy synergy among departments, and there was a "fragmentation" problem. The research and development subsidies from the science and technology department, the talent policies from the human resources department, and the payment policies from the medical insurance department failed to form a joint force; there were also "last mile" problems in policy implementation, and some small and medium-sized enterprises had low awareness and great difficulty in applying for the research and development subsidies policy of the High-tech Zone. The insufficient policy synergy led to an unsatisfactory institutional environment for the development of new quality productive forces, and failed to fully stimulate the vitality of market entities.

Enterprise Practice Cases for the Cultivation of New Quality Productive Forces

Jiaobo Pharmaceutical: The Innovative Path of Specialized, Innovative, and High-Quality Development

Guangdong Jiaobo Pharmaceutical, as the leading enterprise in the biopharmaceutical industry of Qingyuan, was founded in 2003, focusing on the research and production of perioperative fields and special injectables. It is a national specialized and innovative "little giant" enterprise. The company has established a "three-in-one" research and development framework and has innovative platforms such as the National Postdoctoral Research Station and the Guangdong Engineering Research Center for Intravenous Fat Emulsion. It has formed an innovation matrix covering seven technical modules. In the cultivation of new quality productive forces, Jiaobo Pharmaceutical adopted three strategies: First, it adhered to the "import substitution + independent innovation" dual drive, successfully developed propofol emulsion injection to fill the domestic gap, and passed dual certifications in China and the European Medicines Agency; Second, it increased research and development investment, accumulating over 36 million yuan in government scientific and technological funds in the past three years, with a research and development personnel ratio of 11.13%; Third, it deepened the cooperation between industry, academia, and research, jointly building an industry-university-research base with Sun Yat-sen University's School of Pharmacy, accelerating the transformation of technological achievements. In 2024, the company's revenue was nearly 350 million yuan, and the fluoribefenate injection and other new products became growth engines, demonstrating the development effectiveness of innovation-driven development.

However, the company's development still faces challenges: it is difficult to recruit high-end talents, and the size of the R&D team is unable to meet the needs of multiple pipeline R&D; the internationalization level is low, and the overseas market development lags behind that of domestic peers [1-15]. These problems reflect the common predicaments of biopharmaceutical enterprises in Qingyuan in the cultivation of new quality productive forces.

Haorui Pharmaceutical: The Practice of Industrial Transfer through Digital Transformation

Guangdong Haorui Pharmaceutical, as a wholly-owned subsidiary of Guangzhou Green Cross Pharmaceutical, was located in the Guangqing Industrial Park, fulfilling the group's strategic positioning of a "global production base". From signing the contract in 2021 to its production start in December 2024, it took only three years, achieving the registration and batch production of four products, demonstrating the "Guangfo speed" of industrial transfer. The new quality productive force practice of Haorui Pharmaceutical is reflected in three aspects: First, the intelligent transformation of the production process, from mixing, granulation to tablet pressing and coating, achieving "closed and intelligent" operations throughout the process, with clean rooms meeting D-level to C-level standards; Second, the replacement of equipment with domestic products, choosing cost-effective domestic equipment in non-core links to reduce production costs; Third, the international layout of the quality system, strictly following GMP norms, laying the foundation for the development of overseas markets. The company has a clear goal, aiming to focus on innovative drug research and overseas markets in Qingyuan, planning to attract more supporting enterprises to settle in through its own implementation, and improving the industrial chain.

The development of the company benefits from the three advantages of Guangqing Industrial Park: management standards are benchmarked against the efficient services of Guangzhou, with the construction from commencement to production taking less than two

years; the transportation advantage close to the expressway entrance reduces the cost of pharmaceutical cold chain logistics; The potential synergy effects brought by the "3+2" industrial cluster (Appendix Table 1). This "Guangzhou R&D + Qingyuan Manufacturing" model provides a useful reference for the cross-regional diffusion of new quality productive forces.

Appendix Table 1: Comparison of Main Indicators of Biopharmaceutical Industry in Qingyuan and Guangdong Province (2024).

Indicators	Qingyuan	Guangdong Province	Percentage (%)
Number of listed enterprises (units)	9	800	1.13
Total industrial output value (billion yuan)	20.4	6000	0.34
R&D investment ratio (%)	About 3	5.8	-
Number of high-tech enterprises (units)	5	1500	0.33
Patent application volume (pieces)	12	25000	0.05

Note: (Data source: Qingyuan City Statistical Bulletin, Guangdong Province Biomedical Industry Report 2024).

South Medicinal Plant Industry: The Ecological Value Transformation of Green Productive Forces

Qingyuan City fully leverages its ecological resource advantages and develops the South Medicinal Plant planting and processing industry in places like Qingxin District and Liannan County, exploring the cultivation path of green new quality productive forces. In 2024, the planting scale of South Medicinal Plants in Qingxin District reached 57,500 mu, with a comprehensive output value of 1.45 billion yuan, forming a planting and processing chain of 57 varieties such as kwaime and yuzhi. The Liannan Yao Medicine Industrial Park, in combination with ethnic medicine characteristics, develops Yao medicine decoctions, health foods, etc., achieving the transformation of ecological value to economic value. The new quality productive features of the South China medicinal industry are as follows: First, it adopts a green production mode, using ecological planting techniques to reduce pesticide usage, which is in line with the green development trend of the biomedicine industry; second, it extends the industrial chain, moving from the cultivation of medicinal herbs to initial processing, extraction, and the development of health products, thereby increasing the added value; third, it integrates "medicine + tourism and culture", developing new business models such as South China medicinal herbs research and development, and health care and rejuvenation, expanding the boundaries of the industry. Qingyuan City plans to achieve a comprehensive industrial chain output value of over 2 billion yuan by 2025, demonstrating the development potential of the new quality productive force (Appendix Table 2).

Appendix Table 2: Comparison of Innovation Capabilities of Key Biomedical Enterprises in Qingyuan City.

Enterprise Name	Percentage of R&D Personnel (%)	Investment in Research and Development (in ten Thousand Yuan)	Number of Patents (Pieces)	Level of Innovation Platform
Jiaobo Pharmaceutical	11.13	3600	28	Provincial Engineering Technology Research Center
Haurien Pharmaceutical	8.5	1200	5	Municipal Enterprise Technology Center
Xinbei Jiang Pharmaceutical	6.2	800	12	Municipal Engineering Technology Research Center
Lanbao Pharmaceutical	5.8	600	8	None

Note: (Data source: Compilation based on enterprise annual reports and government public information).

However, the South China medicinal industry is still in its initial stage, facing issues such as insufficient standardized cultivation, weak processing capabilities, and small brand influence. It needs to enhance quality through technological innovation and increase value through brand building, achieving the transformation from resource advantages to industrial advantages.

Countermeasures for Driving Industrial Upgrading with New Quality Productive Force

Build an Innovation System and Strengthen the Core Driving Force

Increase the Intensity of Research and Development Investment: Establish a diversified research and development investment mechanism: Set up a municipal biomedical industry development fund with a scale of no less than 1 billion yuan to guide the participation of social capital; implement an additional deduction policy for enterprise research and development expenses, allowing a 175% tax deduction based on the actual investment; provide a maximum of 100 million yuan in phased subsidies for the research and development of first-class new drugs, covering the entire cycle from preclinical research to post-market monitoring. Strive to achieve that by 2027, the research and development investment of the biomedical industry in Qingyuan City accounts for more than 8% of the operating income, approaching the advanced level of the province (Appendix Table 3).

Appendix Table 3: Framework of Policy Support System for Biomedical Industry in Qingyuan City.

Policy Level	Policy Name	Core Support Measures
Municipal Level	Support for Talent's Technological Research and Transformational Innovation Incentive Measures	Subsidy of 1 million yuan for major scientific and technological special teams, and 300,000 yuan for transformational teams
Hengqin Science and Technology Park	Several Measures to Promote the Innovative Development of Biomedical Industry	Maximum subsidy of 50 million yuan for new drug clinical research, and maximum subsidy of 500,000 yuan for medical device research
Guang-Fo Industrial Park	Eight Policies to Promote High-Quality Economic Development	Enterprise relocation award, commencement and production investment award, technological transformation investment award, talent award, etc.
Municipal Level	"Medicine Pass" Platform Construction Policy	Electronic prescription circulation, direct medical insurance settlement, intelligent fund supervision

Note: (Data Source: Compilation of policies at all levels in Qingyuan City).

Build High-Level Innovation Platforms: Implement the innovation platform upgrading plan: Collaborate with universities and research institutions in the Guangdong-Hong Kong-Macao Greater Bay Area to jointly build the "Belt and Road Biomedical Collaborative Innovation Center" in the Qingyuan High-tech Zone, focusing on the development of public service platforms such as drug discovery and safety evaluation; build the "Guangdong Intravenous Formulation Engineering Research Center" in Jiaobo Pharmaceutical to enhance the R&D capabilities of complex injectables; layout the "Biomedical Pilot and Incubation Base" in the Guang-Fo Industrial Park to provide process development and small-scale production services for start-ups. Strive to have 1 new national-level innovation platform and 5 new provincial-level platforms by 2027, enhancing the concentration of innovation resources.

Accelerate the Digital Transformation Process: Formulate a digital transformation roadmap for the biomedical industry: Provide a maximum of 5 million yuan in subsidies for enterprises' intelligent transformation projects, focusing on the construction of digital workshops and intelligent detection systems; promote the application of artificial intelligence in drug screening and clinical trial design, build an "AI Drug Research Public Service Platform"; rely on the "Medicine Connect" platform to establish a full life cycle traceability system for drugs, improving regulatory efficiency. Encourage enterprises such as Haorui Pharmaceutical to build intelligent factory demonstration projects, forming replicable digital transformation experiences.

Optimize the Factor Allocation Mechanism and Lay a Solid Foundation for Development

Implement the Talent-Strong Foundation Project: Build a multi-level talent cultivation and introduction system: Set up the "Qingyuan Biomedical Talent Special Fund", introducing 5 leading talents and 50 high-end R&D talents each year, providing a maximum of 5 million yuan for relocation subsidies; collaborate with universities such as Guangdong Pharmaceutical University to build a "Biomedical Industry College", providing targeted training for applied talents; implement the "flexible recruitment" model, attracting experts from Guangzhou and Shenzhen to provide technical services in Qingyuan on weekends. Improve the talent evaluation mechanism, incorporating new drug research results and technology transfer benefits into the evaluation standards for professional titles, breaking through the bottleneck of talent incentives. Strive to increase the proportion of talents with master's degrees or above in the biomedical field to more than 15% by 2027.

Innovate Financial Support Policies: Improve the biomedical investment and financing system: Set up a 2 billion yuan biomedical industry investment fund, adopting a "mother fund + direct investment" model to support enterprise development; implement the "R&D Loan" product, providing a maximum of 10 million yuan in credit loans for innovative enterprises, with 30% of the loan interest subsidized by the government; Establish a "government-bank-insurance"

cooperation mechanism to provide risk compensation for new drug research projects. Promote the listing and financing of high-quality enterprises such as Jiaobo Pharmaceutical, and support enterprises in expanding their financing channels through methods such as intellectual property pledge and financial leasing.

Improve the Level of Land Intensive Utilization: Implement the action plan for upgrading and enhancing the quality of parks: Conduct land utilization efficiency assessment for key parks such as Guang-Fo Industrial Park, and establish a "per mu tax revenue" assessment mechanism to force the exit of inefficient land use; Implement the "standard land + commitment system" reform to enable biopharmaceutical projects to "start construction upon land acquisition"; Plan a "biopharmaceutical industry complex" in the High-tech Zone and build multi-story standard factories to increase the land floor area ratio. By 2027, the land investment intensity of key parks is expected to increase to over 5 billion yuan per square kilometer, and the output intensity is expected to increase to 10 billion yuan per square kilometer.

Improve the Industrial Ecosystem and Promote Coordinated Development

Improve the Industrial Chain: Implement the plan for strengthening the industrial chain: Introduce raw material and drug excipient production enterprises upstream, and build a "pharmaceutical intermediate product park" in Guangqing Industrial Park; Support Jiaobo Pharmaceutical to expand the capacity of anesthetic drugs in the middle stage and cultivate 2-3 backbone medical device enterprises; Develop professional services such as CRO and CMO in the downstream, and introduce contract research organizations and pharmaceutical distribution enterprises. Establish a "chain leader" system, with the mayor serving as the chain leader, to coordinate and solve key bottleneck problems. Strive to form a complete industrial chain with an annual output value of over 5 billion yuan by 2027.

Deepen Regional Collaborative Cooperation: Integrate into the biopharmaceutical industry collaborative network of the Greater Bay Area: Establish strategic cooperation with Guangzhou International Bio-Island and Shenzhen Pingshan Biomedical Base, and jointly build a "innovation drug and medical device research satellite town"; Utilize the "Hong Kong-Macao Drug and Medical Device Access" policy to pilot the introduction of Hong Kong and Macao listed drugs and medical devices in Qingyuan, and conduct clinical application research; Promote policy intercommunication and resource sharing between Guang-Fo Industrial Park and Guangzhou Science City to undertake high-end pharmaceutical manufacturing links. Regularly hold "Greater Bay Area Biopharmaceutical Industry Connection Meeting" to promote the cross-regional flow of innovation resources.

Optimize Policy Coordination Mechanism: Establish a biopharmaceutical industry development joint meeting system, with the mayor serving as the convener, to coordinate and integrate policy resources from departments such as science and technology, industry and information technology, health, and medical insurance; Compile the "Compilation of Biopharmaceutical Industry Policies of Qingyuan City", providing "one-stop" policy guidance for enterprises; Conduct policy implementation assessment. and implement "immediate submission, immediate review, immediate approval" for research subsidies, talent rewards, etc. Draw on the experience of Guangzhou's "1+N" policy system to form a policy support system covering the entire chain of research, production, circulation, and use.

Strengthen Green Development Orientation, Cultivate Distinctive Advantages

Promote the High-Quality Development of South Medicine Industry: Implement the South medicine industry upgrading plan; Develop planting standards for local medicinal herbs such as ginkgo and yushu, and build a 50,000 mu standardized planting base; Build a "South medicine intensive processing park" in Qingxin District, develop products such as Chinese herbal decoctions, extracts, and health foods, Utilize the resources of Liannan Yao medicine, build a "ethnic medicine innovation center", and develop new drugs and characteristic preparations of Yao medicine. Build the "Qingyuan South Medicine" regional public brand, and enhance the product value through geographical indication certification. Strive to make the South medicine industry chain reach over 5 billion yuan in annual output value by 2027.

Develop Green Biomanufacturing: Cultivate new biomanufacturing tracks, Support enterprises to adopt green production technologies such as enzymatic synthesis and biological transformation to reduce the use of organic solvents, Promote clean energy in the biopharmaceutical park and build a distributed photovoltaic power system; Develop biopharmaceutical industry green factory standards and carry out energy conservation and carbon reduction renovations. Strive to include Qingyuan in the pilot program for the construction of the Guangdong Province Biomanufacturing Industry Innovation Base, and cultivate 1-2 green biomanufacturing demonstration enterprises.

Build a "medicine + culture tourism" integrated business model Taking advantage of the ecological advantages of Qingyuan, develop biopharmaceutical and health tourism products: Build a "Traditional Chinese Medicine Culture Expo Park" in the South Medicinal Resources Industrial Park, and carry out planting experiences and science popularization education activities; Utilize the hot spring resources to develop health care projects such as medicinal baths and medicinal cuisine; Hold the "South Medicinal Nutrition Culture Festival" to enhance the industry's influence. Promote the combination of biomedicine and rural revitalization, through the "enterprise + cooperative + farmer" model, to drive farmers to grow South Medicinal Resources and increase their income and prosperity.

Conclusion and Outlook

Main Research Findings

This paper systematically analyzed the mechanism and path of new quality productivity driving the development of the biopharmaceutical industry in Qingyuan City, and reached the following conclusions: First, new quality productivity provides a new impetus for the development of the biopharmaceutical industry. Its core is achieved through multi-dimensional effects such as technological innovation, factor optimization, industrial collaboration, and institutional innovation, promoting the transformation of the industry towards high technology, high efficiency, and high quality. Qingyuan City has formed distinctive foundations in areas such as anesthetic drugs and South Chinese medicinal plant cultivation, but is still at the initial stage of cultivating new quality productivity. Second, the biopharmaceutical industry in Qingyuan City shows a steady growth in scale and continuous optimization in structure, forming a spatial layout of "two zones, three counties, six parks". Companies such as Jiaobo Pharmaceutical and Haoran Pharmaceutical have made positive progress in innovation research and digital transformation. In 2024, there were 9 above the scale enterprises, with a total output value of 2.04 billion yuan, but there is still a significant gap compared to core cities in the Greater Bay Area. Third, the development of the industry faces bottlenecks such as insufficient innovation capabilities, imbalanced factor allocation, and incomplete ecosystem.

Specifically, it is manifested as low R&D investment, shortage of high-end talents, broken industrial chain, and weak collaboration, which restricts the formation and diffusion of new quality productivity. Fourth, the cultivation of new quality productivity requires the construction of a comprehensive support system for scientific and technological innovation, factor allocation, industrial collaboration, and green development. Through measures such as building high-level innovation platforms, optimizing talent capital allocation, improving the industrial chain, and deepening regional cooperation, it promotes high-quality development of the industry.

Research Outlook

As the Guangdong Province's biopharmaceutical industry approaches the trillion-dollar scale, Qingyuan City faces rare development opportunities. Future research can deepen in three aspects, First, quantify the contribution of new quality productivity to industry growth and establish a scientific evaluation index syste; second, track the research on the collaborative effect of Guangqing industries, analyze the sustainability of the "Guangzhou research + Qingyuan manufacturing" model, third, explore the mechanism for realizing the value of ecological products, and study the path innovation for the green development of the South Chinese medicinal plant industry. The key to the development of the biopharmaceutical industry in Qingyuan City lies in basing on ecological advantages and integrating into the Bay Area pattern, achieving "catching up by taking a detour" through the cultivation of new quality productivity. With the implementation of various policy measures; Qingyuan is expected to become a new highland for the innovative development of the biopharmaceutical industry in the northern part of Guangdong Province, injecting strong impetus into the high-quality development of regional economy.

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