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Development Situation and Strategy Analysis of Waxy Corn Processing Industry in Chongqing Municipality

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Abstract With the development of society and economy and increasing awareness of people's diet and health care, the demand for waxy corn and its processed products has been rising. At present, the planting of waxy corn in Chongqing is taking shape, but the waxy corn processing is still in the initial stage with smaller enterprise scale and fewer processing product variety. Based on the analysis of the development advantages and disadvantages of waxy corn processing industry in Chongqing, this paper brings forward the development ideas and strategies of Chongqing waxy corn processing industry from three aspects of production, processing and policy.

Key words Waxy corn, Processing industry, Circular economy, Policy support, Chongqing Municipality

1 Introduction

With the social progress and economic development, people are increasingly concerned about their own health, and the health care awareness is also growing, thereby increasing the demand for green and organic food. Waxy corn, also known as sticky corn, originated from China's southwestern tropical and subtropical regions^[1]. It is rich in nutrients, and the content of protein, amino acids, vitamins and other nutrients is higher than that of ordinary corn. Its unique flavor is favored by the public, with high food value and broad market prospects^[2]. In recent years, China has made great progress in the product development and comprehensive processing and utilization of waxy corn. The primary processed products include fresh waxy corn, quick-frozen waxy corn, canned waxy corn, *etc.* The deep processed products include starch, starch sugar, alcohol, *etc.* At present, the waxy corn processing products in Chongqing Municipality are mainly primary processed products, with low added value and weak market competitiveness. This paper makes an in-depth analysis on the development advantages and development disadvantages of waxy corn processing industry in Chongqing Municipality. Based on this, from the waxy corn production, waxy corn processing and policy, this paper brings forward the development ideas and development strategies of waxy corn processing industry in Chongqing Municipality.

2 Development advantages of the waxy corn processing industry in Chongqing Municipality

2.1 The natural resource endowment suitable for the waxy corn cultivation

Chongqing is located in the upper reaches of

the Yangtze River, and has a subtropical monsoon climate, with the annual average temperature of 16–18°C, the annual sunshine time of 1 000–1 200 d, and abundant rainfall (annual rainfall of 1 000–1 450 mm). The landscape is dominated by hills and mountains, and the area of sloping land is very large, which is very suitable for planting and growing waxy corn. Presently, the waxy corn planting has begun to take shape, and the planting area is about 20 000 ha. Due to the hot summers and warm winters, long frost-free period in Chongqing Municipality, the sowing and planting can be conducted by different seasons and different regions, so we can properly prolong the cycle of coming into season for waxy corn, so as to improve the planting efficiency of waxy corn. In the suburbs of the two rivers, we can promote the cultivation of waxy corn in early spring, advance the sowing date of waxy corn, and correspondingly make the fresh ear come into market in advance. In other regions with abundant soil resources and water resources, we can carry out the planting in late spring and autumn so that the waxy corn is in delayed supply. The large temperature difference between day and night in Chongqing Three Gorges reservoir area, is good for sugar storage, and the waxy corn produced is of good quality, which can be used as high quality resource for waxy corn deep processing enterprises. Due to the high altitude and vertical terrain change, the southeast Chongqing area forms three-dimensional climatic conditions, which can be used to carry out the staggered sowing, and make the waxy corn come into season in a balanced state.

2.2 The waxy corn breeding in the leading domestic level

The waxy corn breeding research in Chongqing Municipality began in the 1980s, and since the 1990s, Chongqing Academy of Agricultural Sciences has successfully cultivated a set of high-strength, high-quality, high-yield, high-resistance and wide-suitability fine waxy corn varieties based on the unique local germplasm resources. Since entering the 21st century, the waxy corn breeding in Chongqing Municipality has focused on the selection of high quality products and has been steadily developing in the high-quality

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ity and high-yielding direction. A three-level improved seed breeding system (selecting and breeding a number of varieties; promoting a number of varieties; reserving a number of varieties) has been established. Now it has bred some waxy corn hybrids with high dry grain yield such as Yunuo 12, Yukenuo 1 and Yunuo 851, and 22 hybrids have passed the local approval and validation, four of which have passed the national approval and identification^[3]. Moreover, as Yunuo 7 waxy corn hybrid passed the validation of southeast, southwest and Huang-Huai-Hai regions in China, Chongqing Municipality has also made major breakthroughs in the selection and breeding of sweet waxy corn and super-high-yield waxy corn. At the same time, it has also carried out multi-point and multi-ecological regional experiments, and put forward a complete set of high-yielding cultivation technique standards and programs of waxy corn from the aspects of sowing date, nursery and field management, *etc.* From the season for fresh ear, frozen preservation, food processing and other aspects, it explores the efficient and comprehensive utilization path of waxy corn, which provides reliable technical support for the healthy development of the waxy corn processing industry in Chongqing Municipality^[4].

2.3 Production tending to large scale and industrialization

In recent years, the waxy corn breeding research is fruitful in Chongqing Municipality, and accordingly, the waxy corn production has also been rapidly developed, tending to large scale and industrialization. The growing area is maintained at about 20 000 ha, and the yield reaches 9 000 – 13 500 kg/ha. The planting efficiency is also significantly improved, 3 to 4 times higher than that of normal corn. It is an effective way for Chongqing Municipality to adjust agricultural industrial structure, develop urban agriculture in suburbs, ecological agriculture in the reservoir area, agriculture in mountainous areas in southeastern Chongqing. Developing the characteristic industry of waxy corn and creating the distinctive agricultural industrial zones, is in line with the characteristics of big Municipality and big village in Chongqing Municipality. And there is small investment in the waxy corn industry, the benefits are great, and the development of waxy corn industry is not only beneficial to increasing farmers' income, but also conducive to accelerating the transformation of traditional agriculture to modern agriculture.

2.4 Constantly increasing demand At present, the waxy corn in Chongqing Municipality is mainly consumed as fresh food, with annual consumption of about 20 million t. However, with the continuous improvement of people's living standards and the awareness of dietary health care, the waxy corn processed products are increasingly being favored by people. At the same time, as the quality of waxy corn processed products continues to improve and varieties tend to diversify, the demand for waxy corn will continue to increase^[5]. Moreover, with the innovation of waxy corn processing technology, the renewal of processing equipments and the shift from low value-added processed products to high value-added processed products, the waxy corn processing industry in Chongqing Municipality will make great strides, and will also lead

to the increase of waxy corn consumption.

3 Development disadvantages of the waxy corn processing industry in Chongqing Municipality

3.1 Low penetration rate of new varieties and improved cultivation techniques

At present, Chongqing's agricultural technology extension system is not perfect, the new varieties of waxy corn and the corresponding improved cultivation techniques as well as the key technologies of comprehensive prevention and control of waxy corn, can not be popularized and applied effectively. In some waxy corn planting areas, the traditional production mode is still followed, the education level of growers is limited, the cultivation technique is backward, and the management method is extensive, so that the quality of waxy corn is unsatisfactory and the yield improvement is also restricted^[6].

3.2 Low added value of processed products and weak competitiveness

Currently, 80% of waxy corn production in Chongqing is for fresh food, 15% of waxy corn production in Chongqing is for storage, and only 5% of waxy corn production in Chongqing is for processing. In the processed products, there are many initial processed products and there is a shortage of high value-added products. It is because the major waxy corn processing enterprises in Chongqing Municipality are dominated by private enterprises, the scale of enterprises is relatively small, and the scientific and technological innovation capacity is weak. The overall processing capacity is not high, and the processed product structure is single, mostly for the primary processed products, including quick-frozen corn, popcorn, corn grit, waxy corn flour, frozen dumpling, black syrup, *etc.*, and the product quality is not stable. The technological content of initial processed products is low, the added value is low, the product efficiency is not high, and the market competitiveness is not strong^[7], which to some extent affects the development of waxy corn processing industry in Chongqing Municipality.

3.3 Imperfect processed product standard system and flawed development mechanism

At present, the overall technical level of waxy corn processing industry in Chongqing Municipality is not high, the products lack the corresponding standards and norms, and the hazard analysis and key control point (HACCP) system has not yet been implemented in the production to analyze the hazard factors for various processing links and determine the precautionary measures^[8]. As for the processing equipment and management, the backward and aging equipments can easily lead to unqualified quality of the products. Due to the lack of virtuous cycle model of mutual promotion among farmer cultivation, enterprise processing, research and development of agricultural research institutes, and agricultural extension agency services, the scientific results related to new varieties and new technologies fail to be transformed into productivity.

3.4 Weak brand awareness and relatively narrow consumer market On the one hand, at present, the variety structure of fresh corn processed products in Chongqing Municipality is sim-

ple, and the publicity efforts of processing enterprises are not enough. In particular, the edible functions of the fresh corn and the product features are not well publicized. People lack complete understanding of the fresh waxy corn, and the consumer market is relatively narrow. On the other hand, the fresh corn processing enterprises have a relatively small scale of operation, weak overall strength and insufficient market development capabilities, failing to form effective synergies to build well-known brands, so the overall influence of products is relatively small.

3.5 Environmental pollution caused by the processing waste

First of all, the waxy corn consumes a large amount of energy during processing, and can generate considerable harmful gases and dusts such as carbon monoxide and sulfur dioxide to be directly discharged into air, thus leading to environmental pollution. Secondly, in the process of processing waxy corn, the soaking, germ separation, dehydration and other processes will produce a lot of wastewater to be directly discharged into the river, and the rot of protein, fat and other organic substances contained in the wastewater will consume oxygen in the water to generate the anaerobic reaction and make the water black and smelly, thus endangering the fish, shrimp and other creatures.

4 The development ideas and strategies for the waxy corn processing industry in Chongqing Municipality

4.1 Waxy corn production The agricultural production entity (farm, individual farmer) is the rational main body of market economy, and in the planting decision-making, the input-output efficiency is usually the main consideration. Only when the input-output efficiency of waxy corn planting has a comparative advantage can the planting scale of waxy corn be possibly expanded. Improving the input-output efficiency of waxy corn requires not only policy support, but also the science and technology research and development of new varieties and application of new technologies. Firstly, it is necessary to increase the efforts to research and develop the high-quality special new waxy corn varieties. Science and technology are the primary productive forces, and there is a need to increase R&D investment in the new high-quality waxy corn varieties, guide agricultural research institutes to innovate varieties based on the unique geographical location and climatic conditions of Chongqing Municipality, actively develop or introduce the waxy corn germplasm resources with the techno-economy characteristics of high yield, disease resistance and high quality, thus breeding the special high quality waxy corn varieties suitable for local planting in Chongqing Municipality. Secondly, take various measures at the same time to promote efforts to extend the waxy corn cultivation techniques. The industrialization of waxy corn can not be separated from the efforts and practices of agricultural extension departments. Therefore, in promoting the large-scale cultivation of waxy corn, Chongqing Municipality must fully mobilize the enthusiasm of agricultural extension departments and increase the promotion of key technologies of waxy corn cultivation, especially the promotion of planting techniques of high quality waxy

corn varieties, guide farmers to use advanced technology, and actively try to plant new varieties, thereby enhancing the efficiency of corn planting and farmers' incomes and promoting the agricultural development.

4.2 Waxy corn processing

4.2.1 Promoting the innovative research and development on the waxy corn processing technology. Firstly, it is necessary to guide and integrate the scientific and technological strength and resources related to the processing of waxy corn. For the processing enterprises in the industry, there is a need to strengthen the cooperation with related research institutes, build a platform for collaborative innovation, introduce incentive mechanisms for the benefit-sharing of production, learning and research, and carry out joint research on major key technologies for processing waxy corn, so as to realize major breakthrough in the waxy corn processing technology, and crack the basic technical obstacles and bottlenecks in the development of the industry. Secondly, the development of new products should be market-oriented. The waxy corn processing enterprises should fully tap the market potential, and develop the processed products well-received by the market based on the internal resources and strength of enterprises, to ensure that enterprises get the return on production and operation. Thirdly, it is necessary to strengthen the industry personnel training. The industry personnel not only include technical personnel, but also include management personnel. The talent shortage has become a constraint on the development of the waxy corn processing industry in Chongqing Municipality. The waxy corn processing enterprises in Chongqing Municipality should regularly conduct the domestic and overseas training in advanced technologies, techniques and concepts for their managers, operators and front-line technicians, so as to provide a solid foundation for the improvement of technological transformation, capacity expansion, process innovation and management efficiency.

4.2.2 Developing the circular economy and building the green waxy corn industry. Circular economy emphasizes the material recycling and mobility, and focuses on the enhancement of resource conservation and resource utilization efficiency. Traditional corn processing industry consumes natural resources and at the same time, the waste from the processing will also cause environmental pollution and ecological risk. Currently, the waxy corn processing industry in Chongqing Municipality is still in its infancy. In order to promote the healthy long-term development of the industry, it is necessary to introduce the concept of environmental protection and develop the circular economy. For the waxy corn processing enterprises in Chongqing Municipality, on the basis of fully demonstrating their own capabilities and the level of development of supporting industries, it is necessary to learn from and absorb the successful modes and practical experiences of circular economy in other regions, actively explore a circular economy development model suitable for them, actively introduce new production plans, production technologies and production lines, develop the new waxy corn processed varieties, and improve the product matrix, in

order to enable enterprises to achieve economic and social benefits as well as environmental benefits, so as to achieve the sustainable development of waxy corn processing industry in Chongqing Municipality.

4.3 Policy

4.3.1 Improving financial support. With the enhancement of China's financial strength, the financial subsidies to the industry are increasingly strengthened, but the current subsidies for the corn processing industry are still weak, never generating the effective stimulus and guidance. In recent years, remarkable achievements have been made in economic development in Chongqing Municipality. The industrial structure has been greatly optimized and the financial strength has been significantly improved. The subsidy plan for the waxy corn processing industry chain can be formulated in light of the current actual situation of corn production, waxy corn processing and consumption in Chongqing Municipality. On the one hand, the special subsidy can be given to the waxy corn processing industry. Relevant government departments can set up special funds to guide and subsidize the waxy corn processing enterprises with good economic returns and exemplary role in Chongqing Municipality in the form of investment subsidies or scientific and technological project foundation, in order to enhance the R & D capability of these enterprises, enhance their production technology and equipment level, so as to lead and promote the overall development of the waxy corn processing industry in Chongqing Municipality. On the other hand, we can increase the planting subsidies for waxy corn farmers. The improved seed subsidy has been implemented for many years, and has played an important role in popularizing the improved varieties of corn. However, with the rising cost of agricultural production in recent years and the impact of other industries, the improved seed subsidies are difficult to effectively mobilize farmers' enthusiasm for planting corn. The deep processing of waxy corn should have a steady supply of raw materials. The government can increase the subsidies for the fine varieties of waxy corn and improve the enthusiasm of farmers for growing waxy corn, so as to increase the output of waxy corn and meet the consumption demand of the waxy corn processing industry. In addition, the government can also give tax concessions to waxy corn processing enterprises, such as investment credits, tax rates, accelerated depreciation and other tax incentives and measures in the industry, in order to reduce the tax burden on enterprises, reduce the production costs of enterprises, and improve their competitiveness in the market. In addition, the government can also give tax concessions to waxy corn processing enterprises, such as investment credits, tax rates, accelerated de-

preciation and other tax incentives and measures in the industry, in order to reduce the tax burden on enterprises, reduce the production costs of enterprises, and improve their competitiveness in the market.

4.3.2 Increasing the financial support to the waxy corn processing industry. The waxy corn processing industry in Chongqing started relatively late, and it is still in the development stage. The scale of enterprises is small, their own capital strength is weak, and the appropriate financial support is needed for production technology upgrading and capacity improvements. For the leading enterprises in the industry, the government can give the corresponding financial support, and offer more concessions in loan approval procedures, interest on loans and repayment period. It is necessary to innovate upon the financial system, and allow the waxy corn processing enterprises to finance through various means, such as trying to carry out registered trademark mortgages and other measures, so as to reduce the financing costs, expand financing channels, solve the bottleneck for the development of industry funds. In addition, there is a need to support the leading enterprises in restructuring, reorganization and listing.

References

- [1] PAN WM. Planting of waxy corn and its products' developing progress [J]. Guangdong Agricultural Sciences, 2010, 37(6): 155 - 157. (in Chinese).
- [2] PENG ZB. Industrialization present status and strategies for development of waxy corn in China [J]. Journal of Maize Sciences, 2004, 12(3): 116 - 118. (in Chinese).
- [3] ZHANG SH, YANG H, LEI KR, *et al.* Analysis of heterosis groups and heterosis models of waxy maize breeding in Chongqing [J]. Southwest China Journal of Agricultural Sciences, 2011, 24(1): 5 - 9. (in Chinese).
- [4] KUANG LK. Discussion on the industrialization of glutinous maize in Chongqing [J]. Southwest Horticulture, 2009(3): 30 - 32. (in Chinese).
- [5] YU XY. The present situation and development prospect of glutinous maize in China [J]. Bulletin of Agricultural Science and Technology, 2013(6): 4 - 5. (in Chinese).
- [6] WANG YF, WANG LM, SHEN XF, *et al.* Origin, classification, variety improvement and industry development of waxy corn [J]. Journal of Hunan Agricultural University, 2007(S1): 97 - 102. (in Chinese).
- [7] GAO W. Research on the development of corn processing industry in Shandong Province [D]. Tai'an: Shandong Agricultural University, 2013. (in Chinese).
- [8] LIU FG, NIU LY, LI DJ, *et al.* Research progress in processing and utilization of fresh corn [J]. Food Science, 2012, 33(23): 375 - 379. (in Chinese).