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"TARO MEETS NEW FOOD GENERATION" —— MARKET INVESTIGATION OF DEEP-PROCESSED TARO PRODUCTS IN LIPU

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Abstract: The old proverb "A steamed taro makes all the neighbors fragrant" proves the unique charm of Lipu taro. In the cloud mountain area of Lipu County, Guangxi, the century-old planting technology is realizing the modernization transformation of traditional technology through technological innovation. Nowadays, the deep processing of Lipu taro has formed a complete industrial chain. In recent years, the public awareness of the deep-processed products of Lipu taro has been very high, but the homogeneity of the products is serious, and the innovation is insufficient. There are still some people who have never bought or rarely bought them, and there is still great development potential in the consumer market. Therefore, this paper analyzes the factors that affect consumers to buy such products, and provides suggestions and future development marketing strategies for Lipu taro deep-processing products merchants.
In this study, by using SPSS statistical analysis, this paper investigates and analyzes the basic information of consumers of Lipu taro deep-processed products, as well as the factors influencing consumers' satisfaction and recognition of Lipu taro, users' emotion and stickiness. The questionnaire survey was carried out with the help of Tencent's questionnaire platform, and the quality of the questionnaire was controlled by reliability and validity analysis in the pre-survey stage, and the Cronbach coefficient was 0.969, which showed that the questionnaire data had good reliability and validity. Finally, 550 questionnaires were collected, 93 invalid questionnaires were eliminated, and 457 valid questionnaires were obtained, with an effective rate of about 83.09%.
Structural equation model was used to explore the influencing factors of consumption willingness of taro in Lipu. By using the grey relational analysis, it is concluded that there is a good correlation between the selected variables. Exploratory factor analysis is used to put forward path hypothesis for three different perceptions. According to the fitting results of the structural equation model, the fitness index has reached the ideal standard, indicating that the overall model has a good path fitting degree, in which two path assumptions, product quality and purchase perception, are established, and new strategies are formulated to influence customers' purchase intention from these two aspects. The K-means cluster analysis is used to classify the consumer groups, and the consumer groups are divided into developmental consumers, key consumers and potential consumers, which shows that different groups have different consumption levels and attitudes towards the deep-processed products of Lipu taro. According to their consumption habits and psychological characteristics, personalized marketing strategies are formulated respectively.
From the market point of view, this paper gives the reference strategy of product marketing model from three aspects: product sales promotion, target consumer groups and product elements promotion, and proposes to deepen market research to accurately locate demand, strengthen product innovation to create differential advantages, pay attention to brand building to enhance influence, strengthen marketing promotion to expand share, strengthen industrial chain cooperation and coordinated development, and inherit and carry forward the social responsibility and sustainable development of Lipu taro deep-processed products.
Keywords: Lipu taro; Deep processing products; Semantic network analysis; Structural equation model; K-means cluster analysis

1 INTRODUCTION

1.1 Research Background and Significance

Lipu taro is a symbolic specialty of Lipu City, Guangxi Zhuang Autonomous[1], enjoying the reputation of "a treasure in the taro", plays a decisive role in the local agricultural economy. By 2023, the planting area of taro in Lipu City has reached 50,000 mu, the annual output has exceeded 100,000 tons, and the annual output value has exceeded 2 billion yuan. This industry has not only promoted the economic income growth of tens of thousands of farmers, but also become a key force to promote the rural revitalization strategy[2].
In Guangxi and South China, Lipu taro, as a necessary delicacy on the banquet table, carries profound cultural implications. However, a large number of counterfeits advertised as "Lipu taro" but not authentic origin have emerged in the market, which makes it difficult for consumers to identify the authenticity only by appearance or taste. What's more, some merchants confuse the genuine with the ordinary taro at a low price, which seriously infringes on the trust and rights of consumers. Lipu taro was once famous as a tribute in the Qing Dynasty, and it was well known to the public through the wide spread of the TV series Prime Minister Liu Luoguo[3]. Nevertheless, its rich historical and cultural connotation has not been fully inherited and carried forward. Among young consumers, Lipu taro is regarded as

a kind of "online celebrity food", but its value as a traditional symbol of local culture has not been given due attention and recognition.

With the upgrading of consumption and the development of agricultural industrialization, Lipu taro has extended from traditional fresh food to deep processing, and gradually formed a food industry chain with taro as the core raw material, which has become an important pillar industry for the revitalization of local villages. Enterprises such as "Guangxi Lipu Yuwang" and "Guilin Mingdian" have sprung up in Lipu, and integrated planting and processing through the model of "company+base+farmer"[4]. Some enterprises have introduced automatic production lines to improve processing efficiency, but the overall industrial concentration is still low, and small and medium-sized workshop-style processing plants account for a relatively high proportion.

Policy support and technical cooperation have contributed to the deep processing of taro products in Lipu. Guangxi has incorporated Lipu taro into the planning of characteristic agricultural industrial clusters, and local governments have provided subsidies to encourage research and development of deep processing technology, and built agricultural products processing parks (such as Lipu Food Industrial Park)[5]. Some enterprises cooperated with Guangxi Academy of Agricultural Sciences and South China Agricultural University to develop taro preservation, freeze-drying technology and extraction of functional components (such as polyphenols and polysaccharides), but the technical conversion rate needs to be improved. In order to support the development of the taro industry in Lipu, in 2023, the Lipu municipal government issued the policy of benefiting the people with the green demonstration planting award of Lipu in 2023, and farmers of Lipu taro can enjoy the 600 yuan award per mu. This policy stimulated farmers' enthusiasm for planting and expanded the planting area of Lipu taro.

1.2 Research Significance

The significance of studying the deep-processed products of Lipu taro is far beyond the category of single industry, and it is a multi-dimensional integration of economic value, rural revitalization, cultural inheritance and green sustainable development. Deep processing can break through the limitation of short shelf life and high transportation cost, and transform Lipu taro into high value-added products, such as ready-to-eat food and functional raw materials, and improve the unit output value. It can also optimize the industrial chain structure, promote the standardization of upstream planting, drive downstream supporting industries, form an integrated model, and enhance risk resistance. As the "hometown of taro", the development of deep processing in Lipu City can attract investment and create jobs, such as factory workers and e-commerce operators, which will inject impetus into the high-quality development of county economy and promote local economic growth. Its taro industry accounts for over 30% of the agricultural output value.

Deep processing helps rural revitalization: guarantee the purchase price and increase farmers' income with the model of "company+cooperative+farmer"; Develop taro theme projects in combination with cultural tourism to promote the integration of rural three industries; Attract talents to return home to start businesses, improve rural infrastructure and narrow the gap between urban and rural areas.

Deep processing promotes sustainable development: recycling by-products, such as skin dregs and defective products, extracting polysaccharides for health care products, producing organic fertilizers or biofuels; Standardize planting, popularize ecological technology and protect local ecological diversity.

1.3 Literature Review

Under the background of globalization, challenges such as population growth, resource constraints and climate change force the transformation and upgrading of agricultural products processing and food industry, and promote the iterative development of agricultural products processing and food innovation in the direction of green, intelligence and high added value by taking technological innovation as the path to drive industrial chain coordination, standardize production system construction and accurate adaptation of consumer demand[6]. Lei Yuliang, Xiao Lin (2024) through the spatial Dobbin model analysis shows that the agglomeration of agricultural products processing industry has a significant positive role in promoting agricultural modernization, and there is regional heterogeneity, and at the same time, it promotes the level of agricultural modernization in neighboring areas through the positive spatial spillover effect[7]. Guan Yonghua and Zhou Qiuhong (2023) think that the agricultural products processing industry in Guangxi has some problems, such as short industrial chain, low added value of technology and insufficient regional coordination. By strengthening the drive of scientific and technological innovation, deepening the integration of the three industries and improving the policy support system, the level of agricultural modernization in Guangxi can be effectively improved, and the rural revitalization and the high-quality development of the real economy can be helped[8].

With the development of Lipu taro industry, it is the premise of product promotion to explore the current public attitudes and views on Lipu taro and its deep-processed products. Bai Jian and Hong Xiaojuan (2022) through the emotional classification and theme analysis of online public opinion barrage[9]. And said that this method can show the emotional tendency and focus of attention of netizens in multiple dimensions; In addition, Ding Liuhua et al. (2023), based on the mining of online comments, used text analysis and social network analysis to conduct qualitative and quantitative research, thus constructing semantic networks and dividing them into different dimensions for further exploration[10].

How to combine Lipu taro with modern food and spread it to a larger market, and explore the factors affecting consumers of Lipu taro deep-processed products has become a top priority. Shi Xiaochen et al. (2023) set various

variables and established SEM structural equation model to verify the influence of various variables on consumers' purchase intention, and then explored the future development model of products and formulated corresponding strategies[11]; Cui Hongcheng and Chen Qingguo (2024) explored users' willingness to continue using products, tested the influencing variables by using the structural equation model, and optimized products and services according to the test results, and put forward relevant suggestions to improve users' satisfaction and willingness to continue using products[12].

Some scholars also have related research on product development and market extension. Qingliang Meng et al. (2014) explored the relationship between customer satisfaction and express service performance by integrating the improved Kano model and IPA analysis method, built the process model of express service quality detection, and gave the decision-making scheme of express service improvement[13]; Dujili et al. (2023) took the park as the research object, determined the priority of park landscape improvement order according to Kano-IPA analysis method through questionnaire data collection and information feedback, and put forward improvement suggestions respectively[14].

In the current era of big data, data mining technology can build a portrait of consumer groups, thus achieving accurate marketing of products. Cai Shaolin et al. (2022) based on K-Means clustering analysis, classified customers and mined information, and constructed a portrait of agricultural products consumers, thus accurately defining target customers, core products and marketing models[15]; Shi Lemeng et al. (2022), in order to explore the influencing factors of young consumers' purchasing behavior of sugar-reduced products, conducted preliminary market research based on questionnaire survey and literature research, obtained consumer portraits through K-Means cluster analysis, and then analyzed the factors and paths influencing consumers' purchasing tendency of sugar-reduced products through structural equation model, thus giving relevant suggestions on product sales methods and industry development trends[16].

1.4 Research Contents and Ideas

In order to understand the market situation of Lipu taro deep-processed products and put forward the future development direction, this paper is divided into six chapters, aiming at discussing the consumer research and market promotion of Lipu taro deep-processed products.

Firstly, the background and significance of Lipu taro are introduced. In order to provide direction and factual basis for the follow-up questionnaire design, this paper uses text mining to conduct a preliminary study on consumer demand. Through Python, Weibo's content with Lipu taro as the key word is crawled, and the word cloud image analysis and emotion analysis are carried out. The LDA theme is constructed to analyze the semantic network of high-frequency words, observe the PMI values between words and judge the core points that consumers pay attention to.

Secondly, based on the above conclusions, we designed the contents of the questionnaire, completed the distribution and collection of the questionnaire, and conducted a pre-investigation. Clean the collected data and analyze its reliability and validity to prepare for further statistical analysis. Determine the sample size, do a good job in quality control of questionnaire survey and strictly implement it. In field research, we use stratified sampling. Firstly, according to the grey relational analysis, we observed the correlation between the selected variables in the heat map, classified the characteristics through exploratory factor analysis, and put forward the path hypothesis for the structural equation model, so as to test the consumption intention. Finally, according to K-means clustering, the potential customers are classified and their characteristics are mined.

Finally, based on the research results and related marketing theories, we put forward the future development direction of Lipu taro deep-processing products, and at the same time provide relevant suggestions for merchants in product innovation, marketing strategy, channel expansion and so on.

1.5 Characteristics and Innovation

1.5.1 Method innovation

The innovation of research methods is reflected in the application of big data and machine learning technology (mining online and offline behavior data of consumers) and visual analysis tools (such as Tableau and Power BI). These methods not only fully capture the characteristics of consumer behavior, but also reveal the key influencing factors and dynamic changes of the consumption willingness of Lipu taro deep-processed products through the structural equation (SEM) model. This multi-dimensional innovative research method provides scientific and accurate data support for research, and at the same time provides a new methodological paradigm for the study of agricultural product consumption behavior, which helps market strategy formulation and product innovation.

1.5.2 Perspective innovation

From the user's perspective, combined with consumer behavior characteristics, this paper focuses on analyzing consumers' personal experience (such as taste and health attributes) and preference trends (such as diversified products, cultural identity and environmental awareness) of Lipu taro processed products, and points out the shortcomings in the current market (such as homogenization, low brand awareness and insufficient promotion).

The potential users of non-Lipu taro deep-processed products were explored. In the process of data analysis, this paper not only analyzes the consumers' willingness to buy the deep-processed products of Lipu taro, but also makes a cluster study on the non-consumer groups who have not bought the deep-processed products of Lipu taro at present, so as to explore their future purchase willingness of the deep-processed products of Lipu taro and provide a series of

improvement suggestions for expanding the product consumption market.

1.5.3 The concept of sustainability

Exploring the successful transformation of Lipu taro into deep processing industry not only optimizes the agricultural industrial structure, but also provides a new impetus for sustainable development for rural revitalization. Dynamic market observation and real-time data, through field research, consumer interviews and sales data analysis, capture the changes of market dynamics and consumption trends, and ensure the timeliness and practicality of research results.

2 RESEARCH SCHEME DESIGN

2.1 The Purpose of Research

In order to fully implement the spirit of the 20th National Congress of the Communist Party of China and thoroughly implement the spirit of General Secretary President Xi's important speech when he visited Guangxi, we should firmly implement the rural revitalization strategy, make overall plans to promote the rural revitalization strategy, and take the transformation and upgrading of agriculture, the prosperity of rural industries and the increase of farmers' income as the goal. As a national geographical indication agricultural product, Lipu taro is not only the most distinctive crop in Lipu city, but also an important driving force to promote the revitalization of local villages and increase farmers' income. Its unique quality and geographical advantages have injected vitality into the development of agricultural economy in Lipu City and become a key industry for farmers to get rich. The development of Lipu taro industry can not only enhance the market competitiveness of local agricultural products, but also provide strong support for the implementation of rural revitalization strategy and help farmers achieve sustained income increase.

Therefore, in order to realize industrial transformation and upgrading, we will speed up the adjustment of industrial structure and further strengthen the development of characteristic industries in Lipu taro around the principle of "market-led, government-driven, diversified investment and characteristic industries". By collecting consumers' ratings on the factors influencing the cognition and consumption habits of Lipu taro deep-processed products, we can formulate more targeted product development and marketing strategies and continuously improve the market competitiveness of Lipu taro price products. The results of the questionnaire survey are also helpful to provide enterprises with the direction of optimizing product quality, improving sales channels and enhancing brand value.

2.2 Research Object and Scope

The subjects of the questionnaire are people with different consumption, people of different age groups and people in different regions. Through the investigation of different consumer groups, we can understand the acceptance, consumption habits and purchasing power of Lipu taro deep-processed products. To investigate the preferences of different age groups for taste, nutritional value and price of Lipu taro, and to investigate the influence of regional culture, eating habits and other factors on the deep-processed products of Lipu taro.

This survey will cover the major consumption areas of Lipu taro in China, including 21 major first-tier cities including Beijing, Shanghai, Guangzhou and Shenzhen, 30 second-tier cities including Nanjing, Chengdu, Wuhan and Changsha, and 43 third-tier cities including Guilin, Dali and Yichang. In addition, Guilin, Guangxi, the specific production place of Lipu taro, will be the key research area of this survey.

2.3 Research Arrangements

The main objective of this survey is to deeply explore the present situation, advantages, market demand and potential in rural revitalization of the deep-processed taro industry in Lipu, Guangxi, especially to make substantial progress on the key issues of upgrading the brand of deep-processed taro products in Lipu, expanding market share and promoting industrial development. Through this investigation, we hope to provide feasible strategic suggestions for the future development of Lipu taro deep processing industry, so as to better promote local economic growth and increase farmers' income, and provide support for the implementation of rural revitalization strategy.

In recent years, with the continuous promotion of the country's rural revitalization strategy, the rural economy is undergoing profound changes. Agricultural products industry, especially characteristic agricultural products, has gradually become an important force to promote rural revitalization. As a local characteristic agricultural product, Guangxi Lipu taro has unique variety advantages and market potential, which has become an important part of industrial revitalization. Therefore, through this survey, we hope to deeply understand the production, processing, sales and opportunities and challenges of Lipu taro deep-processed products, and provide data support and theoretical basis for the improvement and branding of its industrial chain.

In the initial stage of the investigation, we first understand the overall development trend of agricultural products industry under the background of rural revitalization through the hot evaluation and analysis of the network platform. In particular, consumers' interest and demand for local specialty agricultural products are also increasing year by year. This kind of information helps us to determine the focus of research on the deep-processed products of Lipu taro, thus exploring the market demand, consumer awareness and consumption habits of the deep-processed products of Lipu taro, and providing effective suggestions for the future development of Lipu taro industry.

In the initial stage of investigation, we collected and analyzed all kinds of documents related to the taro industry in Lipu, which provided us with an overview of the development status of the deep processing industry of Lipu taro, including the distribution of producing areas, main production enterprises, processing technology and market sales. By analyzing the existing data of Lipu taro deep processing industry, we made clear the research direction and specific objectives, and ensured the smooth development of the follow-up research work. At the same time, we also actively paid attention to the policy documents related to rural revitalization and the state's support policies for the development of agricultural industry. These policies provide a good environment for the sustainable development of agricultural products industry, and also provide an opportunity for the upgrading of Lipu taro deep processing industry.

In the middle stage of investigation, we went deep into the production base of Lipu taro in Guilin, Guangxi, and visited the main planting areas of Lipu taro and related agricultural cooperatives. Through face-to-face communication with local farmers and enterprises, we learned about the production of Lipu taro, including planting scale, yield, quality control, harvesting and processing. In addition, we also conducted a detailed investigation on the upstream and downstream links in the industrial chain of Lipu taro, and learned the whole process from planting, processing to sales. In order to further understand the demand and consumption trend of consumers, we designed a questionnaire survey on the consumption market of Lipu taro and its deep-processed products. By distributing questionnaires in different regions and different consumer groups, we have obtained a lot of data about consumers' preferences and purchase frequency of Lipu taro deep-processed products. These data provide valuable reference for our subsequent market analysis and product positioning.

In the final stage of the investigation, we made a detailed analysis of the collected data. First of all, through the statistical analysis of the questionnaire data, we understand the consumer's awareness, purchase perception, community influence, purchase intention and the changing trend of market demand for Lipu taro deep-processed products. Secondly, using data analysis tools such as SPSS and Python, we made a multi-dimensional analysis on the production cost, market price fluctuation and consumer behavior of Lipu taro, and revealed the main challenges and development opportunities faced by the deep processing industry of Lipu taro at present.

Based on the preliminary understanding of the market of Lipu taro deep-processed products, we have made plans for the follow-up questionnaire design, distribution and data analysis.

3 INVESTIGATION AND IMPLEMENTATION

3.1 Preparatory Preparation

3.1.1 The market scale of modern Lipu taro deep-processed products is good

According to statistics, by 2023, the planting area of taro in Lipu City, Guangxi Province exceeded 200,000 mu, and the annual output exceeded 300,000 tons, accounting for more than 15% of the total national taro production. A "planting-processing-selling" integrated industrial chain has been formed in the local area, and the number of deep processing enterprises has increased to more than 200, with an annual processing capacity of 100,000 tons, driving the output value of the whole industrial chain to exceed 5 billion yuan. In order to tap the consumption trend and capture the emerging demand, through Baidu index The platform analyzes the behavior data of netizens.

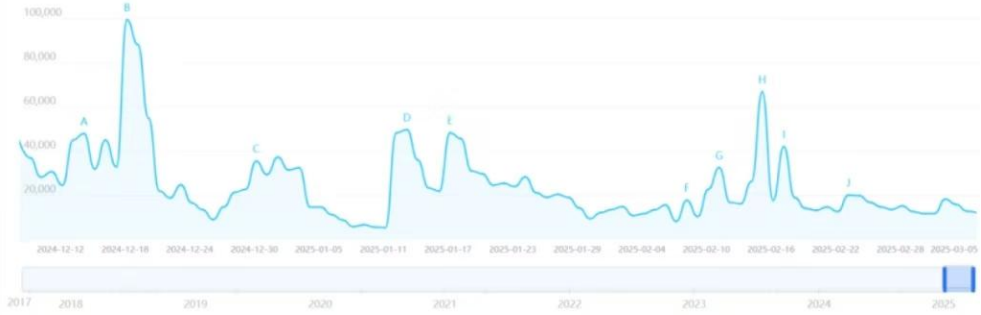

Figure 1 Trend Chart of Search Volume for "Lipu Taro"
Image source: Baidu Index (https://index.baidu.com/v2/index.html#/)

In Baidu index, search, filter and analyze with "Lipu taro" as the key word to obtain its search index trend chart, such as Figure 1. As shown. As can be seen from the figure, the search index of "Lipu Taro" was relatively high in December 2024. By January-March 2025, although the search index was not so high, there was a relatively stable search index every day, which indicated that people continued to pay attention to the Lipu Taro market steadily.

Similarly, through the search and analysis of "Lipu taro" as the key word, the demand map is obtained. The correlation between netizens' needs and keywords is divided into three layers, and the intensity gradually weakens from the inside out, in which the circle size represents the search index size, green represents the index decline, and red represents the index increase. It can be seen that the words with the strongest correlation with "Lipu taro" are Xiangsha taro, Yuhuazhai street, accounting service company, etc., which shows that netizens are extremely accidental in searching for

this keyword, and we need to further understand its development status.

In the wave of upgrading the deep processing industry of agricultural products in the past 20 years, the taro industry in Lipu has undergone a transformation from traditional rough processing to high value-added deep processing, and gradually built a modern industrial chain system covering raw material supply, product innovation and brand marketing, guided by the evolution of consumers' demand for health, convenience and multiple scenarios. Nowadays, consumers' attention to "low sugar and low calorie", "instant convenience" and "functional attributes" continues to heat up, which promotes the extension of Lipu taro deep-processed products from single raw materials to snack, prepared food, healthy meal replacement and other sub-fields, which not only activates the market potential of traditional taro products, but also analogizes innovative products such as quick-frozen taro paste and taro chips into new tea, baking and healthy food tracks. Under this background, relying on the rural revitalization policy to support characteristic agricultural products, Lipu taro industry is exploring a new path of "geographical indications+industrial innovation" to drive the nationalization of regional brands through the integration of deep processing technology empowerment and consumption scenarios, providing a demonstration sample for the transformation and upgrading of Guangxi characteristic agriculture.

3.1.2 Lagging of the development status of Lipu taro deep-processed products

In this research, consumers who are willing to buy deep-processed products of Lipu taro are taken as the research object. Because of limited funds and short time, we choose to distribute questionnaires directly online, including online media such as Questionnaires, QQ, WeChat, etc., so as to obtain questionnaire data quickly. In recent years, although the deep processing industry of Lipu taro has made some progress under the support of large-scale planting and policies, its production infrastructure construction is still lagging behind, which is difficult to meet the needs of high-quality development of the whole industrial chain. The concrete manifestations are: insufficient iteration of processing technology, weak standardization and quality control[17]. And lack of market plan and brand premium. In addition, small and medium-sized processing enterprises are generally faced with the problem of shortage of funds. Nearly 80% of enterprises have fallen into the "low-end OEM" mode because they are unable to invest in the renovation of aseptic workshops and the upgrading of intelligent production lines, and their new product research and development and brand marketing capabilities are seriously insufficient. According to the industry survey data in 2023, the output value of deep processing of taro in Lipu only accounts for 9.2% of the total scale of taro products in China, which is seriously out of balance with its position of raw material output accounting for 15% in China. In the Baidu index, search for the term "Lipu taro" to get the regional and age distribution map.

Figure 2 Regional distribution of search index for "Lipu Taro"

Image Source: Baidu Index (https://index.baidu.com/v2/index.html#/)

By Figure 2, it can be seen that the areas with high search index of "Lipu Taro" are mainly Guangdong, Guangxi, Shandong, Jiangsu, Zhejiang, Fujian and other places, mostly in the eastern coastal areas, which shows that the propaganda of Lipu Taro in Guangxi is not in place and its popularity is not high.

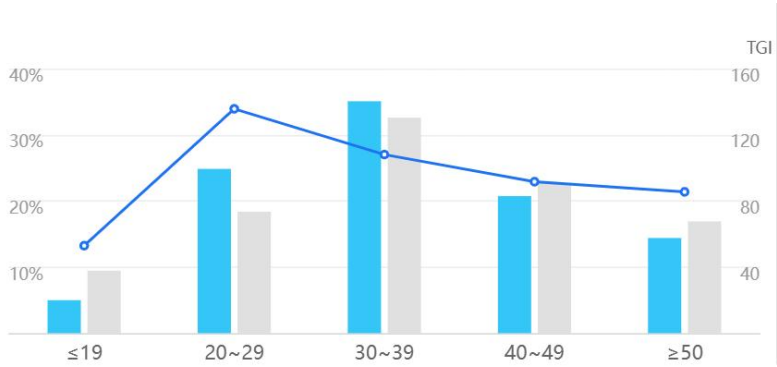

Figure 3 Age distribution of search index of "Lipu taro"
Image source: Baidu Index (https://index.baidu.com/v2/index.html#/)

By Figure 3, it can be seen that most of the search groups of "Lipu Taro" are 30-39 years old, followed by young people aged 20-29. Because when TGI is equal to 100, this kind of users' attention to a problem is at an average level, and when TGI is greater than 100, it is higher than the overall level, so it can be seen that people aged 20-39 pay more attention to Lipu taro than the average level, which can be used as our research object.

3.2 Questionnaire Design

In order to make the questionnaire achieve ideal results and convey detailed and accurate data information, in the statistical investigation report, the questionnaire design should follow the following principles: First, the functional principles, including the principles of consistency, completeness, accuracy and feasibility, ensure that the questionnaire questions are clearly expressed, the questions are consistent, avoid ambiguity and make the respondents easy to understand. Second, the principle of neutrality, question design should remain neutral, avoid guiding respondents' answers, and ensure the objectivity of data. Third, the principle of orderliness, the order of arranging questions should be organized, from general to specific or from simple to complex, in order to improve the participation of respondents. Fourth, comprehensive coverage, the questionnaire should comprehensively cover the main aspects within the scope of research to ensure comprehensive information. Fifth, the principle of adaptability, according to the purpose of the study and the characteristics of the object, design questions to ensure the adaptability and effectiveness of the questionnaire, and use the simplest inquiry method under the condition of ensuring the same information. Sixth, the principle of pre-test, pre-test before the formal implementation, test the rationality and effectiveness of the questionnaire through small-scale investigation, and adjust the questions in time.
Combined with the specific investigation, this paper explores consumers' willingness to consume the deep-processed products of Lipu taro to determine the questionnaire structure.

3.3 Pre-Investigation

After the completion of the questionnaire, in order to ensure the effectiveness and quality of the questionnaire, the investigation team conducted a pre-survey on the questionnaire before it was officially distributed. A total of 155 questionnaires were collected through one-on-one pre-survey, of which 150 were valid.

3.3.1 Reliability analysis

Reliability is reliability, which refers to the consistency of the results when the same method is used to measure the same object repeatedly. Reliability indicators are mostly expressed by correlation coefficients, which can be roughly divided into three categories: stability coefficient (cross-time consistency), equivalence coefficient (cross-form consistency) and internal consistency coefficient (cross-project consistency). According to the characteristics and specific requirements of the survey, we finally use Cronbach's alpha to analyze the reliability. This method is suitable for the reliability analysis of attitude and opinion scale (questionnaire). The final calculated results are shown in the following table.

Table 1 Pre-investigation reliability test

Variable name	Measurement coefficient	Cronbach's Alpha	
external factor	five	0.946	
internal factor	four	0.952	0.969
Other factors	three	0.900	

By Table 1, it can be seen that the overall α coefficient value (Cronbach's α value) is 0.969, which is greater than 0.9, and the α coefficient of a single question is also greater than 0.9, which is acceptable, so it shows that the questionnaire

has strong internal consistency and stability.

3.3.2 Validity analysis

Validity refers to the accuracy of the measurement tool, that is, the degree to which the measurement results can reflect the characteristics to be measured. The higher the validity, the better the purpose of the questionnaire test can be achieved. In measurement theory, validity is defined as the ratio of the true variance related to the purpose of measurement to the earned score variance in a series of measurements. The validity analysis results of the pre-survey data are shown in the following table (Table 2).

Table 2 KMO and Bartlett sphericity test in pre-investigation

KMO value		0.806
Bartlett sphericity test	Approximate chi-square	501.684
	df	66
	P value	0.00

Secondly, the exploratory factor analysis of the questionnaire data shows that the overall KMO value is 0.806, which is acceptable, and the significance is less than 0.01. The variables are independent, so it is suitable for factor analysis and the questionnaire content is valid. Therefore, for the questions fed back in the pre-investigation, the content and structure of the questionnaire are further improved and optimized.

3.4 Sampling and Samples

3.4.1 Determine the sample size

According to the actual situation, this survey mainly adopts stratified sampling to conduct questionnaire survey because consumers in various cities are the research objects. According to the sample size estimation formula of sampling survey, the sample size of this survey is calculated.

$$n_0 = \frac{Z^2 * P(1-P)}{E^2} \tag{1}$$

In general, the acceptable sampling limit error E in the above formula is 0.045, the confidence is 95%, and the estimated proportion P is 0.5. After calculation, the sample size is about 475.

According to the pre-survey distribution, we estimate that the efficiency of the questionnaire is about, so the questionnaire should be distributed.$n_0 = n_0/a \approx 495$

According to the general experience, it is estimated that the recovery rate of the questionnaire is 90% under the explanation of online researchers, so the sample size is adjusted to.$n_2 = n_1/b \approx 550$

For the convenience of statistical processing, we finally decided to distribute 550 questionnaires.

3.4.2 Sampling method

As the scope of this survey covers consumers in cities at various levels in China, and the designed population is large, stratified random sampling is conducted to ensure the effectiveness of sampling. The stratified standard is based on the data of the seventh national census, and the total resident population in eastern, central, western and northeastern regions is selected, and the sample size of each region is calculated by proportion, as shown in the following table (Table 3).

Table 3 Stratified Sampling Ratio by Region

region	Permanent population (10,000)	Sampling proportion	Sampling quantity
eastern region	56372	0.3993	220
middle	36469	0.2583	142
the west	38285	0.2712	149
northeast	98515	0.0698	39

3.5 Data Processing and Entry

A total of 550 questionnaires were distributed through online questionnaire survey and offline passers-by interview interception. After excluding invalid questionnaires such as logical contradictions, unanswered questions and short filling time, 457 valid questionnaires were finally obtained, with an effective rate of 83.09%, which met the statistical requirements. Input the questionnaire data through EXCEL, and analyze its reliability and validity through SPSS. The results are shown in the following table:

Table 4 Formal Investigation Reliability Test Form

Variable name	Measurement coefficient	Cronbach's Alpha	
external factor	five	0.964	0.977
internal factor	four	0.965	

Other factors	three	0.930

By Table 4, it can be seen that the Cronbach's alpha value of the result is 0.977, which means the reliability of the result is 97.7%. If it is greater than 0.8, it means that the reliability of the questionnaire is good, so we can continue statistical analysis.

The validity of the valid data of this formal investigation is analyzed, and KMO and Bartlett sphericity tests are used to get the results in the following table.

Table 5 Formal survey validity test form

KMO value		0.864
Bartlett sphericity test	Approximate chi-square	1265.588
	df	91
	P value	0

By Table 5, it can be seen that the KMO value of the questionnaire data is 0.864, which is greater than 0.8; And the significance level is 0.000, less than 0.05. Then the synthesis can show that the questionnaire has passed the validity test and the expected results can be obtained.

3.6 Quality Control

We mainly use online questionnaire survey to collect data, and there may be some phenomena such as random filling and random crossing, which will affect the overall data quality. Therefore, we mainly adopt the following methods for quality control:

Quality control of research planning: after determining the research topic, we know the scale and development status of the current Lipu taro deep-processing product market through online inquiry and market report, and consult relevant documents about the Lipu taro deep-processing industry, so that all members can think deeply about the research content and purpose, ensure that each member has a clear and unified idea about this research, and ensure the integrity and efficiency of the research work.

Quality control of questionnaire design: after consulting a large number of documents related to the research topic, communicate with the tutor to determine the questionnaire survey method as the main method of this formal research. When designing the questionnaire topic, make the questionnaire topic concise, logical and systematic. In addition, invalid answering questions are set on the "Tencent Questionnaire" platform to prevent the data from being unreliable due to the respondents' careless answers, so as not to affect the whole research work.

Quality control of questionnaire pre-investigation: before formal investigation, small-scale questionnaires are distributed for experiments, and whether the contents of the questionnaires are reasonable or not are checked through trial filling, and the problems existing in the questionnaires are corrected according to the feedback of the respondents, so as to improve the contents and order of the questionnaire topics again.

Quality control of formal investigation: In order to avoid data errors caused by respondents' cognitive errors, appropriate explanations should be given in time to improve the authenticity and accuracy of questionnaire answers. All questionnaires were screened, and the questionnaires with obviously inconsistent answers and logical contradictions were treated as invalid.

Quality control after investigation: after the investigation, the questionnaire will be reviewed twice. When more invalid questionnaires are found, more questionnaires need to be distributed to ensure the sample size, and the collected data will be sorted and summarized in time until the required sample size is met. Before the data analysis, the reliability and validity were tested to ensure that the questionnaire data were reliable and valid.

4 Descriptive Statistic

4.1 Analysis of the Basic Situation of the Respondents

In the gender distribution of the respondents, the proportion of men is 40.9%, and that of women is 59.1%. On the whole, the proportion of men and women is about 4:6, and the gender ratio is not much different. In the age distribution, the proportion of people aged 18-30 is 54.3%, and the proportion of people aged 31-45 is 35.2%. Most of the respondents are young, which is beneficial to our questionnaire survey of deep-processed products.

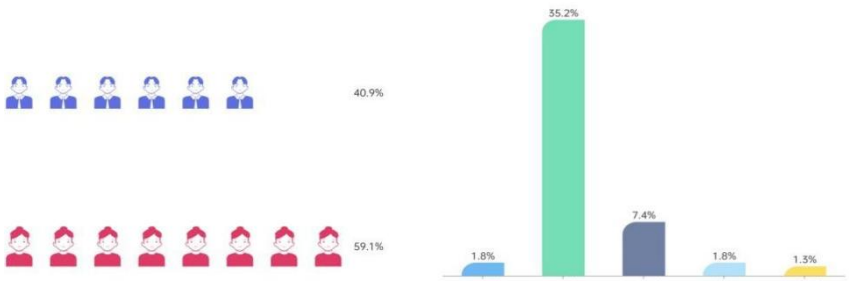

Figure 4 Gender and Age Distribution Map

In the regional distribution of the respondents (Figure 4), the provincial capital accounts for the largest proportion, accounting for 44.4% of the total, followed by districts and counties, accounting for 34.4% of the total, and rural areas account for 7%, which is the least number of all regions. Reflects the distribution of respondents in different regions. In the distribution of living expenses or wages, the number of people with expenses of 2000-4000 accounts for the most, accounting for 34.7%, followed by the number of people with expenses of 4000-6000, accounting for 26.7%, the number of people with expenses of more than 6000 accounts for 22.8%, and the number of people with expenses of less than 2000 accounts for 15.8%.

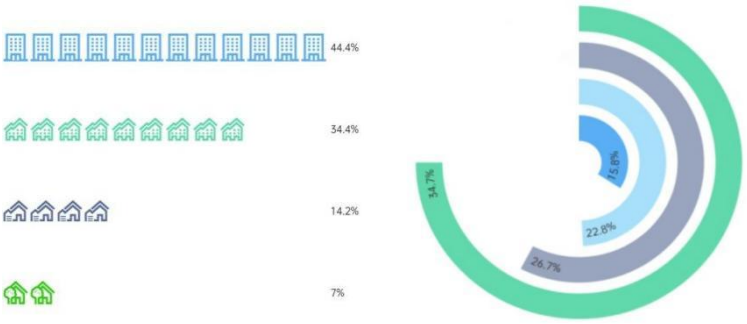

Figure 5 Distribution Map of Area and Living Expenses

In the distribution of working status, the number of employees is the largest (Figure 5), accounting for 64.3%, followed by students, accounting for 19%. The respondents are more suitable for people who know about deep processing. In the distribution of education level, undergraduate or junior college accounts for the largest proportion, up to 72.9%, followed by high school or technical secondary school. This group of people are willing to spend money on food and are more in line with the respondents (Figure 6).

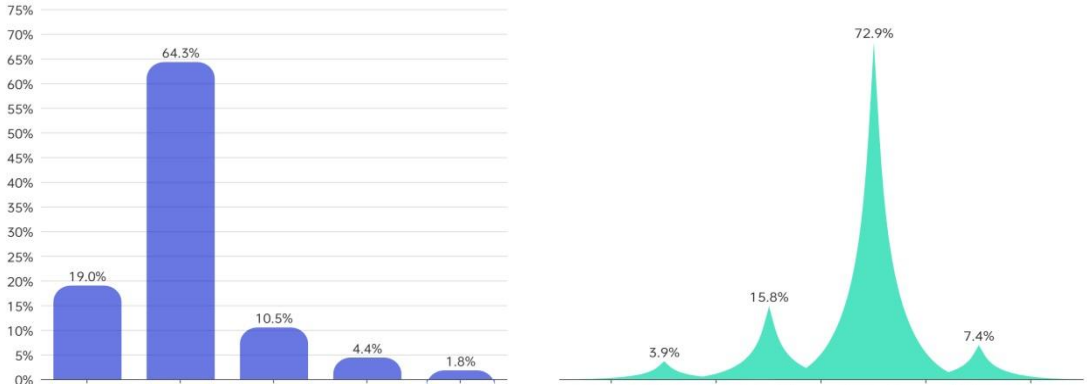

Figure 6 Distribution Map of Working Status and Education Level

4.2 Descriptive Statistics of Questionnaire Data

4.2.1 Respondents know the channel of Lipu taro

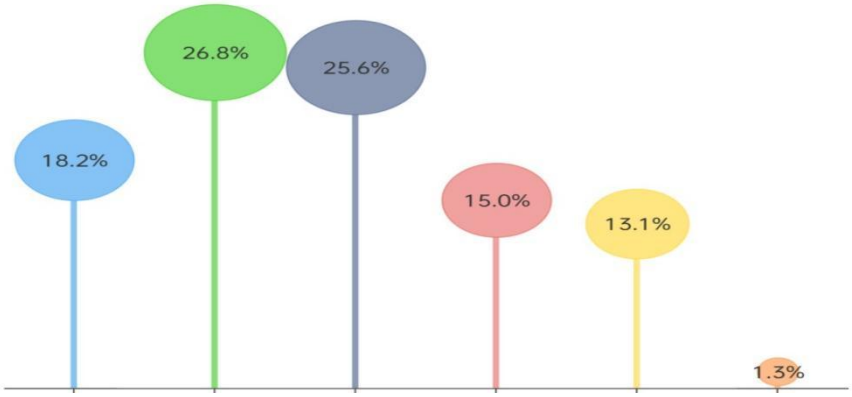

Figure 7 Respondents Know the Channel of Lipu taro

Such as Figure 7 As shown in the figure, it can be known that the channels for respondents to learn about Lipu taro are mainly through e-commerce platforms and social media, which shows that network communication plays a positive role in Lipu taro. Of course, through the recommendation of family and friends, TV advertisements and offline supermarkets, Lipu taro can also be spread to a certain extent, making the communication efficiency higher and letting more and more people know about this variety. In order to improve the market competitiveness of Lipu taro and promote the development of its deep-processed products, producers should make use of these or even more channels to publicize and improve their popularity.

4.2.2 The frequency of respondents buying deep-processed products of Lipu taro

According to the data in Figure 8 43.7% people buy the deep-processed products of Lipu taro 1-3 times a month, only 11.4% people buy the deep-processed products 1-3 times a week, and even 15.3% people never buy them. This means that most people are still willing to buy the deep-processed products of Lipu taro, but not all people like to buy them, and the time interval of purchase is determined by personal needs.

Figure 8 Frequency of Purchasing Deep-Processed Products by Respondents

4.2.3 Products that respondents prefer to buy

Such as Figure 9 as shown, the number of people who like to buy ready-to-eat snacks (such as taro strips, taro cake, etc.) and drinks (such as taro milk tea, taro plant milk, etc.) is the largest, with little difference, accounting for 27% and 29.2% respectively. However, fewer people buy condiments (such as taro sauce), only 6.6%. It can be found that, in fact, most people prefer dessert-like processed products, so positioning products on making rich and varied desserts can attract more customers, expand the market scale and promote the development of deep processing industry of taro in Lipu.

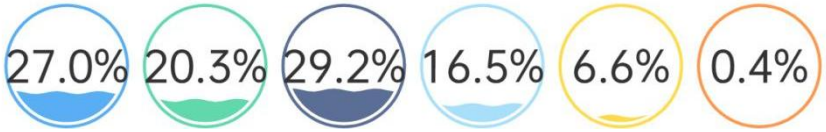

Figure 9 Products that Respondents Prefer to Buy

4.2.4 The purpose of the respondents to purchase the deep-processed products of Lipu taro

FromFigure 10, it can be seen that most people buy deep-processed products mainly for their daily consumption, and 33.9% people are willing to buy them to try new flavors, which shows that Lipu taro deep-processed products are more common in daily life. At the same time, 26.3% people choose deep-processed products as gifts, which shows that the deep-processed products of Lipu taro have a wide audience. For enterprises of this kind of products, different packaging can be designed according to customers' needs, and consumers can freely choose and buy goods according to the purpose of purchase when purchasing, and promote marketing according to the classified packaging strategy.

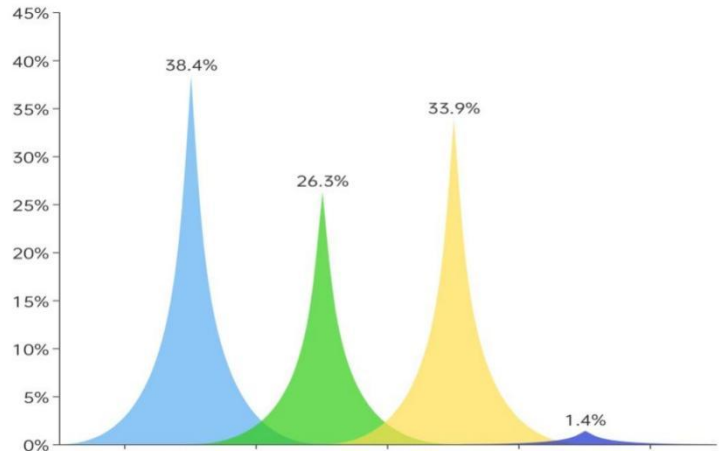

Figure 10 The Purpose of the Respondents to Buy Deep-Processed Products

4.3 Lipu Taro Deep-Processed Products Consumption Trend Analysis

Have you ever heard of Lipu taro?

Regarding whether or not you have heard of Lipu taro, according to the data collected by the questionnaire, 81.4% of people have heard of Lipu taro, and only 18.6% have not, which shows that the publicity and promotion of Lipu taro are not bad. Enough people know about Lipu taro, which provides an opportunity for us to follow up on the development of its deep-processed products (Figure 11).

Figure 11 Have you Heard of Lipu Taro

For the respondents who have never bought the deep-processed products of Lipu taro.

4.3.1 The main factors of not buying deep-processed products

Such as Figure 12 as shown in the figure, there are three main reasons why the respondents didn't buy the deep-processed products of Lipu taro: they have doubts about the quality or safety, they don't know about such products and the price is too high, which account for 24.3%, 22.7% and 22.7% respectively, while 11% people prefer to buy fresh taro, which shows that it is very important to strengthen the promotion of its deep-processed products. Enterprises should introduce to the public that the deep-processed products still retain many nutrients and unique taste of Lipu taro, invite food bloggers to try and recommend products, and carry out promotional activities.

Figure 12 Main Factors of not Buying Deep-Processed Products

4.3.2 Factors that make respondents who have not bought try to buy

Such as Figure 13, it can be seen that 32.3% people are willing to buy if they try to eat offline; 26.9% people are willing to buy if there is a clear product efficacy description. In order to encourage more people to buy the deep-processed products of Lipu taro, improve the market competitiveness and expand the market scale, enterprises can choose suitable venues, invite others to try them on the premise of ensuring the quality of the tried products is consistent with the products sold, or distribute information listing the efficacy, ingredients and applicable people of the products.

Figure 13 Factors of Trying to Buy

In view of the respondents who have purchased the deep-processed products of Lipu taro.

4.3.3 External factors considered when purchasing deep-processed products

By Figure 14, it can be seen that consumers consider many factors when purchasing the deep-processed products of Lipu taro. First of all, whether there are promotional activities will greatly affect the public's choice. The preferential strength of promotional activities can attract customers who have never tried the product before, and can also give back to old customers, and customers can enjoy lower prices or more gifts. Secondly, the price of products is also a key factor for consumers to consider, and many consumers pursue high cost performance when buying products. The convenience of purchasing channels also enables consumers to obtain goods quickly and meet the current demand. In addition, the brand effect is also concerned by consumers, and having a good reputation will win the trust and love of consumers.

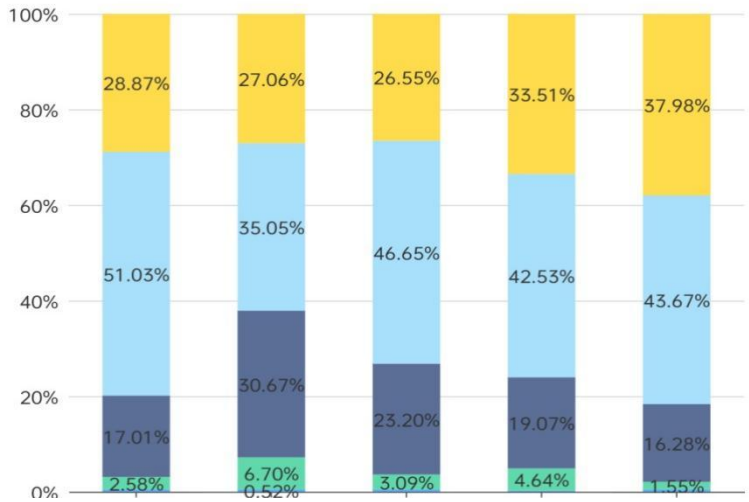

Figure 14 Factors of Trying to Buy

4.3.4 Internal factors considered when purchasing deep-processed products

By Figure 15, it can be seen that from the four aspects of taste, nutritional value, quality and shelf life, consumers should first consider the taste when purchasing the deep-processed products of Lipu taro. The taste is the first thing consumers feel when tasting food, which directly affects consumers' acceptance and love of the products. Secondly, quality and shelf life are the basic requirements of consumers for food safety and stability; Finally, the nutritional value is considered. Lipu taro itself is rich in various nutritional components, and it is more inclined to be used as a delicious snack or convenience food when purchasing its deep-processed products.

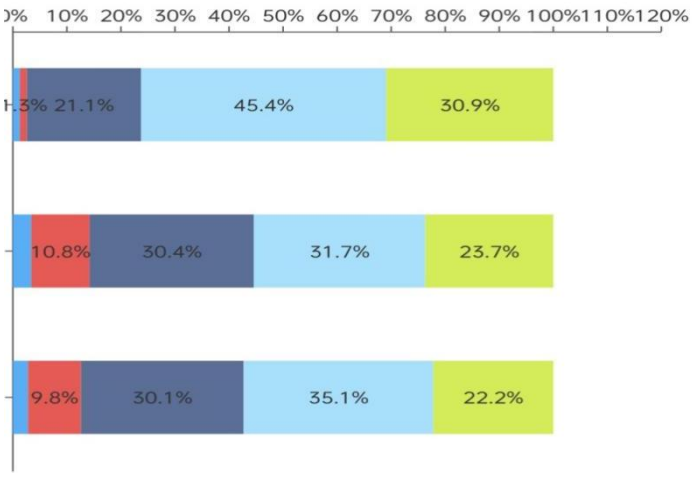

Figure 15 Social Factors Affecting the Purchase of Deep-Processed Products

5 MODEL APPLICATION

5.1 Based on SEM Model, Explore the Influencing Factors of Consumption Willingness of Lipu Taro Deep-Processed Products

5.1.1 Correlation analysis of grey correlation degree

Question 16 (Would you like to recommend Lipu taro deep-processed products to your friends or family?) and question 18 (18. Are you willing to pay a higher price for the high-quality deep-processed products of Lipu taro?) and questions 13-15 are analyzed by grey correlation degree to explore the correlation between variables (Figure 16).

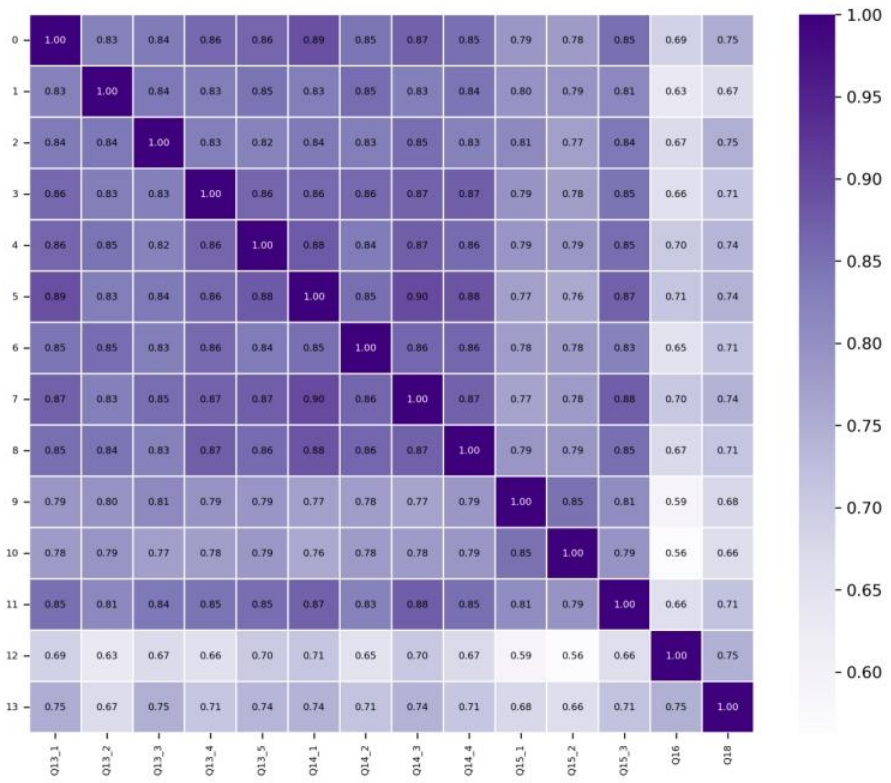

Figure 16 Heat Map of Correlation between Variables based on Grey Correlation Analysis

After dimensionless treatment of each variable by Python, the grey correlation values are calculated respectively, and the heat map as shown in the above figure is drawn[18]. According to the above figure, it can be found that there is a good correlation between the variables in this analysis.

5.1.2 Exploratory factor analysis

In order to explore the influencing factors of consumption willingness of deep-processed taro products in Lipu, 14 variables were introduced, namely question 13, question 14, question 15, question 16 and question 18.

Firstly, the exploratory factor analysis (EFA) method is used[19]. The principal component analysis of the selected sample data is carried out by SPSS software, and the factor load matrix is obtained by the maximum variance method, and the KMO and Bartlett test values are output to preliminarily determine whether this data is suitable for factor analysis, and to judge whether the factor structure determined in this paper is reasonable (Table 6).

Table 6 KMO and Bartlett Sphericity Test in Exploratory Factor Analysis

KMO metric		0.868
Bartlett's sphericity test	Approximate chi-square	1097.925
	df	55
	sig.	0.00

The test value of KMO and Bartlett is 0.868, which is higher than the threshold of 0.8, indicating that it is very suitable for factor analysis, and the value of sig. is 0.00, which is lower than the threshold of 0.5, so it can be concluded that the selected questionnaire sample data has a good modeling matching degree. The factors are extracted by dimensionality reduction. When four factors are extracted, the cumulative variance explanation rate is 90.7%, and the variance of each common factor is between 0.5 and 0.9, indicating that four factors can better explain the questions and variables in the questionnaire. Thus, the rotated component matrix is obtained, as shown in the following table (Table 7):

Table 7 Rotated Component Matrix

variable	ingredient			
	one	2	three	four
Q13_1: Price	0.831			
Q13_2: Packaging	0.803			
Q13_3: Brand Effect	0.761			
Q13_4: Channel Convenience	0.719			
Q13_5: Promotion Activities	0.698			
Q14_1: Taste		0.842		
Q14_2: Nutritional value		0.816		
Q14_3: Quality		0.779		
Q14_4: Shelf life		0.748		

Q15 1: Promotion of celebrity endorsement	0.885	
Q15_2:IP joint name	0.869	
Q15_3: Recommended by family and friends	0.818	
Q16: Would you like to recommend the deep-processed products of Lipu taro to your friends or family?		0.891
Q18: Are you willing to pay a higher price for the high-quality deep-processed products of Lipu taro?		0.876

Through the above analysis, and according to the item semantics and factor load size, we can know from the rotation component matrix table that we can get a four-factor model and name the common factors respectively:
Purchasing perception: Q13_1, Q13_2, Q13_3, Q13_4, Q13_5.
Product quality: Q14_1, Q14_2, Q14_3 and Q14_4.
Community influence: Q15_1, Q15_2, Q15_3.
Consumption intention: Q16, Q18

5.2 Study the Path Hypothesis

According to the relevant literature research, this paper discusses the influencing factors of consumers' willingness to accept Lipu taro products combined with modern food. According to the analysis of influencing factors of product satisfaction by Xiong Wenzhen and Xu Jianxin, it is found that there is a significant positive effect on product price, packaging, taste and aroma when evaluating product purchase and satisfaction[20]. Therefore, combined with the results of exploratory factor analysis, this paper puts forward the following assumptions:
Hypothesis H1: Purchasing perception positively significantly affects consumers' willingness to consume Lipu taro products.
Suppose H2: the product quality positively and significantly affects consumers' willingness to consume Lipu taro deep-processed products.
In addition, this study also focuses on consumers' perception of community influence to promote their willingness to buy agricultural products. Zhang Qiyao and Li Na's empirical research based on the four-factor model of perceived value shows that perceived value has a significant positive impact on consumers' purchase intention of deep-processed agricultural products brands through the intermediary role of brand trust, while the negative adjustment of brand appeal of fresh agricultural products on the relationship between brand trust and purchase intention is not significant. Therefore, combined with the results of exploratory factor analysis, this paper puts forward the following assumptions:
Suppose H3: community influence positively and significantly affects consumers' willingness to consume Lipu taro deep-processed products.

5.3 Fit Test and Fitting Results of Equation Model

In this study, chi-square freedom ratio (CMIN/DF), approximate root mean square error (RMSEA), growth fitness index (IFI), Tucker-Lewis index (TLI) and comparative fitness index (CFI) were used to evaluate the fitting results. The fitting values of this study are as follows (Table 8):

Table 8 Test Results of Modified Model Fitness

index	reference standard	Measured results	Fitness evaluation
CMIN/DF	1/3 is excellent, 3/5 is good.	2.624	excellent
RMSEA	< 0.05 is excellent, < 0.08 is good.	0.065	good
IFI	> 0.9 is excellent, > 0.8 is good.	0.904	excellent
TLI	> 0.9 is excellent, > 0.8 is good.	0.854	good
CFI	> 0.9 is excellent, > 0.8 is good.	0.901	excellent

According to the fitting results of the model constructed in this study, except RMSEA (root mean square error) and CMIN/df (chi-square freedom ratio) are acceptable standards, the other indicators GFI, RMR, IFI and CFI all meet the ideal standards, indicating that the model constructed in this study has a good overall fitting degree and can be further analyzed.

Table 9 Model Path Fitting Result

Path relation	Standard path coefficient	S.E.	C.R.	P
Consumer Willingness <-Purchase Perception	0.730	0.082	8.923	***
Consumer willingness <-product quality	0.795	0.113	7.044	***
Consumption intention <-community influence	-0.24	0.103	-1.761	0.078

According to Table 9, it can be seen that the product quality positively affects the consumption intention (β=0. 795, p<0.05) in the path hypothesis relationship test of this study, so the hypothesis H1 holds; Purchase perception positively affects consumption intention (β=0.730, p<0.05), so it is assumed that H2 holds; Community influence negatively affects consumption intention (β=-0.24, p>0.05), so it is assumed that H3 is not valid.

5.4 Test Results and Summary

Table 10 Hypothetical Test Results

research hypothesis	Research conclusion
H1: Purchasing perception positively and significantly affects consumers' willingness to consume the deep-processed products of Lipu taro.	found
H2: The product quality has a positive and significant impact on consumers' willingness to consume Lipu taro deep-processed products.	found
H3: The community influence positively and significantly affects consumers' willingness to consume the deep-processed products of Lipu taro.	false

(1) Product quality has a significant positive effect on customers' consumption intention, and the path coefficient is 1.18. Taste and nutritional value are the factors that consumers pay more attention to the quality of products. Taste directly enhances the consumption experience, and nutritional value meets the health needs. In addition, quality and shelf life enhance trust and ensure the safety and quality of products. Quality is the cornerstone of brand, and safety is the bottom line of products. Turning the bottom line of safety into the high line of market competition will eventually form a strong cognitive bond of "quality is brand" in consumers' minds (Table 10).
(2) Purchasing perception has a significant positive effect on consumers' willingness to spend, and the path coefficient is 0.96. Price, packaging, brand effect and channel convenience jointly drive consumption decision. It shows that consumers are influenced by purchase perception factors when they buy deep-processed taro products in Lipu, Guangxi. Increasing the cost performance of products, establishing a good brand image and enhancing the convenience of purchase have become important factors affecting consumers' purchase behavior, which should be paid attention to.
(3) The influence of community has no significant influence on customers' willingness to consume, which shows that the influence of community has no obvious influence on the purchase and premium willingness of products when consumers buy, so the influencing factors of purchase perception can be ignored in the subsequent promotion and marketing of products.

5.5 K-Means Clustering

5.5.1 K-means clustering algorithm

K-means clustering analysis is a common unsupervised learning algorithm, which is used to divide the data set into clusters, so that the data points in the same cluster have high similarity, while the data points in different clusters are quite different. Its goal is to minimize the total distance between the data points in the cluster and the center (centroid) of the cluster, so the K-means clustering algorithm is described as follows[21]:
(1) initialization
Let the total sample set be a set of n sample combinations, and the number of clusters is, divide the sample set into classes at will, mark it as, calculate the corresponding initial clustering centers, mark it as, and calculate: $\mathrm{G} = \{w_j, j = 1,2, \ldots, n\}\mathrm{C}(2 \leq \mathrm{C} \leq \mathrm{n})\mathrm{GC}G_1, G_2, \ldots, G_c\mathrm{C}m_1, m_2, \ldots, m_cJ_e$

$$J_e = \sum_{i=1}^{C} \sum_{w \in G_i} \|w - m_i\|^2 \tag{2}$$

Among them, the smallest cluster is the optimal result under the criterion of sum of squares of errors.J_e

(2) Iteration of clustering centers
According to the principle of minimum distance, the samples are clustered, namely: $G_i = \emptyset(i = 1,2, \ldots, C)w_j = (j = 1,2, \ldots, n)$
if

$$\mathrm{d}(w_j, G_k) = \min_{1 \leq 2 \leq C} d(w_j, m_i) \tag{3}$$

Then, and recalculate the cluster center:$w_j \in G_k, G_k = G_k \cup \{w_j\}, j = 1,2, \ldots, n$

$$m_i = \frac{1}{n_i} \sum_{w_j \in G_i} w_j, i = 1,2, \ldots, C \tag{4}$$

Where is the number of samples in the current class and recalculate.$n_iG_iJ_e$
(3) If the two iterations are unchanged, the algorithm terminates, otherwise the algorithm goes to (2).J_e

5.5.2 Selection of the number of clusters

In this paper, the consumer's gender, age, living area, salary level, working status, education level, willingness to buy products and payment premium are used as the basis for classification, and K-means clustering is used to classify consumer behavior. Python is used to analyze the data, and the optimal K value is selected by the Elbow Method. With

the increase of cluster number K, the total sum of squares (SSE) of the clustering model gradually decreases, but when K increases to a certain critical value, the SSE value decreases slowly, forming an "inflection point" or "elbow". The k value corresponding to this inflection point is usually considered as the optimal number of clusters. As shown in the figure below, we choose the value of k as 3 (Figure 17).

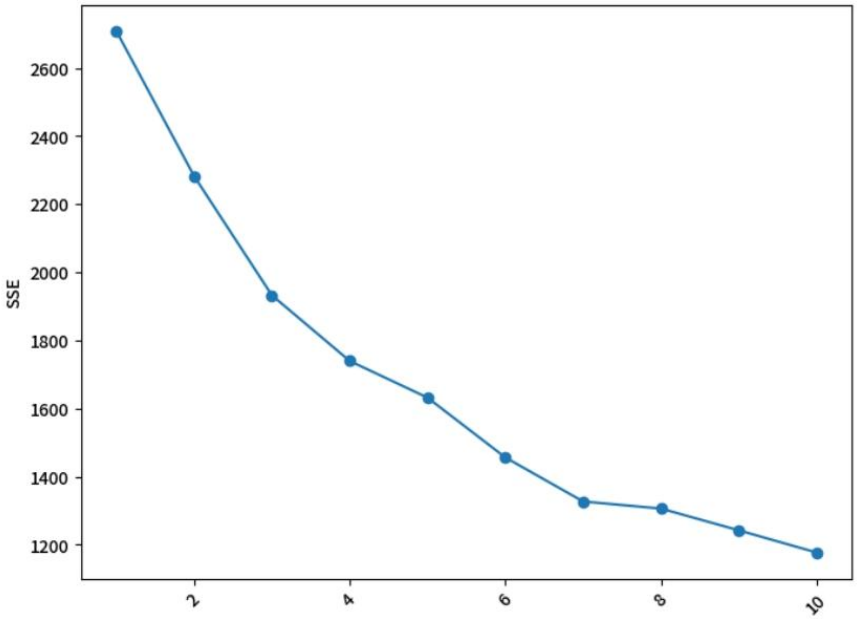

Figure 17 K Value and Corresponding Elbow Diagram

5.5.3 Cluster result analysis

According to the clustering results, the sample data are divided into three categories based on K-means model, and the proportion of people in each category is as follows Figure 18 as shown.

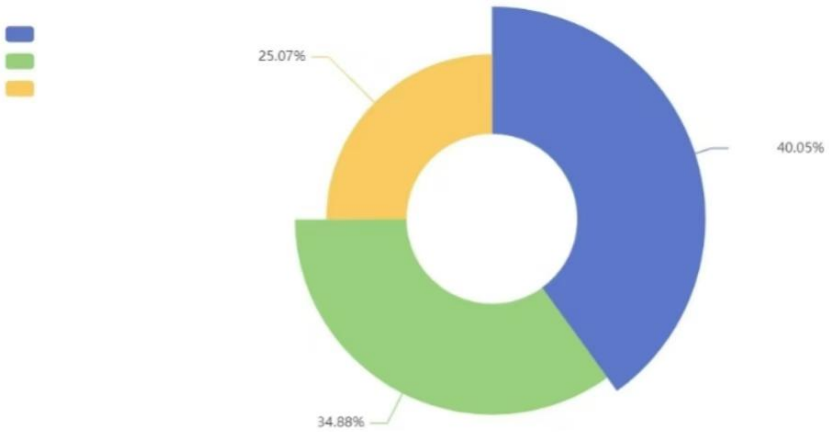

Figure 18 Percentage of Consumers in Each Cluster Center

According to the situation of each cluster feature, the radar map of cluster feature is made to observe the situation of each cluster consumer group more clearly (Figure 19).

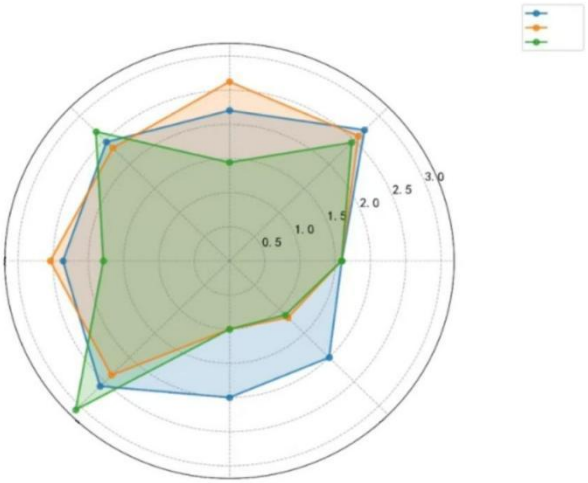

Figure 19 Cluster Feature Radar Map

Combined with the questionnaire data, the whole consumer is pictured first, and then the whole consumer is subdivided into three categories by integrating the K-means clustering proportion diagram and the characteristic radar diagram, and the in-depth consumer portrait and difference analysis are carried out. The analysis results are as follows:

Overall portrait of consumers: According to the respondents' information, the age group of 18-30 years old accounts for 54.3%, among which students and employees are the main consumers. There are more highly educated people, accounting for 72.9%, which shows the preference of highly educated people for Lipu taro deep-processed products. Most of these people live in cities with high pressure and moderate consumption level, ranging from 2000 to 4000 yuan. Such consumers generally recognize the deep-processed products of Lipu taro and are willing to pay a certain premium for the deep-processed products of Lipu taro.

The first cluster: balanced consumers. This group presents a balanced feature of "no outstanding shortcomings and no obvious preferences", with a large age span of 25-45 years old. The monthly consumption level is not high, around 2000-4000, and the consumption intention is at a medium level. The demand for deep-processed products of Lipu taro is concentrated in daily high-frequency scenes (such as family breakfast and refreshments). Consumer decision-making relies on public reputation and regular promotion, and prefers basic products with high cost performance (such as instant taro paste and taro cakes). Widely distributed in the region, it has low sensitivity to the cultural connotation or health attributes of products, but it has basic requirements for the safety of raw materials. It is suggested that through omni-channel distribution and mass marketing, the label of "daily nutrition" should be strengthened, and large-capacity products for family packaging should be developed to improve the repurchase rate.

The second cluster: key consumers. The core characteristics of this group are "regional concentration and high income stability", and the areas are mostly distributed in provincial capitals and districts and counties, with stable jobs and high income, and strong acceptance of the payment premium for the deep-processed products of Lipu taro. Prefer joint products with regional characteristics (such as taro moon cakes with local brands), and the consumption scene has social attributes. The decision-making path is easily driven by promotional activities, and at the same time, it pays attention to the brand and tends to make products with brand effect. It is suggested that products should be customized according to the culture of the target area, accurately promoted through the local life platform, and the attribute of "quality socialization" should be strengthened.

The third cluster: potential consumers. This group is marked by "high education, high income and high health concern". It is a youth group aged 28-35, and most of them live in provincial capitals. Pursue the healthy attributes of Lipu taro deep-processed products, and is willing to raise the consumer price for the technological innovation and cultural connotation of the products. The consumption scene is biased towards fitness meal replacement and high-end catering customization, and the decision-making relies on professional evaluation and knowledge platform information, and the willingness to share socially is strong (such as spreading a healthy lifestyle through Xiaohongshu). For this kind of consumer groups, it is suggested to introduce high-end products with organic certification and nutrition visualization (such as dietary fiber meal replacement powder), build a "health+quality" content matrix with nutritionists and fitness KOL, and tap the historical and cultural value of Lipu taro to match its pursuit of quality of life, so as to cultivate and improve the consumption willingness of this kind of groups.

6 RESEARCH CONCLUSIONS AND SUGGESTIONS

6.1 Conclusion

Starting from the development of rural revitalization product "Lipu Taro" and guided by the popular trend of modern food, this study conducted a research on the combination mode of Guangxi Lipu Taro and modern food, and made an inquiry and analysis on the market analysis and development trend, market opportunity mining and marketing

suggestions. Among them, the questionnaire survey was distributed by means of the Questionnaires platform, and the questionnaire structure was adjusted after the pre-survey. Finally, 550 questionnaires were collected and 93 invalid questionnaires were eliminated, and the number of valid questionnaires was 475, with an effective rate of about 83.09%. The quality of the questionnaire is controlled in terms of survey planning, questionnaire design, questionnaire pre-survey and formal survey. The results show that the reliability of the questionnaire is 0.977 and the validity is 0.864, indicating that the questionnaire data has good reliability and validity. In this paper, Python web crawler, structural equation model (SEM) and K-means clustering model are mainly used for research and modeling analysis. Finally, through the analysis of the questionnaire data, the following conclusions are drawn:

6.1.1 Integration and innovation: a new era of Lipu taro and modern food industry

In the current wave of healthy food consumption, the combination of the traditional value of Lipu taro and modern food processing technology has opened a new chapter in the deep processing of characteristic agricultural products. By developing innovative products such as taro paste pre-products, instant taro chips and taro baking raw materials, it not only retains the dense and sweet characteristics of Lipu taro, but also meets the diversified needs of the market for convenience foods, healthy snacks and catering raw materials. This innovation breakthrough is not only reflected in the expansion of product matrix, but also runs through the whole process of supply chain optimization, scene marketing and regional brand building. With the improvement of consumers' awareness of the quality of regional agricultural products and the emphasis on nutritional functions such as dietary fiber, the economic value and cultural connotation of Lipu taro have been deeply developed. The integration of traditional ingredients and modern food industry marks a new stage of improving quality and increasing efficiency in the field of deep processing of agricultural products.

6.1.2 Potential release: multidimensional value reconstruction of characteristic agricultural products

As a national geographical indication product, Guangxi Lipu taro is showing amazing development potential. The research obtained the consumption data of e-commerce platform and social media through Python crawler, and found that the interaction volume of topics related to "Lipu Taro" increased. The hot words of consumer concern generated by WordCloud show that the characteristics of "regional scenery", "taste evaluation" and "food collocation" are the most concerned. SnowNLP emotional analysis shows that consumers' satisfaction with taro deep-processed products is 42.46%, and negative emotions account for 33.82%, indicating that they are more positive about Lipu taro. Semantic network analysis reveals that the market demand has been upgraded from primary agricultural products to ready-to-eat and functional directions, and consumers' acceptance of the brand premium of "Lipu Geographical Indications" has increased.

6.1.3 Value identification: the core logic of building consumption stickiness

In the highly competitive health food market, it is very important to establish consumers' continuous recognition of regional agricultural products. Through the structural equation model (SEM) analysis, it is found that three factors, purchase perception (0.96), product quality (1.18) and community influence (-0.30), have significant influence on repurchase intention, among which the concept of "food modernization" associated with product quality factor has the greatest influence weight. This shows that consumers' experience of purchasing products directly affects their willingness to pay premium. Combined with IPA-KANO mixed model analysis, the research and development should focus on two high-value dimensions of "instant convenience" and "nutrition visualization". K-means-based consumer clustering shows that young customers pay more attention to product innovation, while family customers pay attention to the traceability of raw materials. Therefore, building a three-dimensional operation system based on quality, cultural empowerment and value resonance is the key strategy to enhance customer stickiness.

6.2 Suggestions

Based on the above conclusions, in order to promote the development of deep-processed products of Lipu taro, the following are specific suggestions:

6.2.1 Deepen market research and accurately locate consumer demand

Enterprises should invest more resources in market research to understand the preferences and needs of consumers of different ages, genders, occupations and regions for Lipu taro and modern food products. The research content can include consumers' preferences on taste, sweetness, packaging, shelf life and price of Lipu taro deep-processed products, as well as their cognition and acceptance of Lipu taro culture. By accurately positioning consumer demand, enterprises can develop innovative products that are more in line with market demand and improve the market competitiveness of products.

6.2.2 Strengthen product innovation and create differentiated competitive advantages

Product innovation is the key for enterprises to gain sustainable competitive advantage. Enterprises can rely on its unique taste and high dietary fiber characteristics to develop diversified product matrix through modern food technology. Research and develop ready-to-use frozen taro paste and seasoning taro powder for the catering market, introduce non-fried freeze-dried taro chips for the healthy snack track, and innovate cross-border fusion products, such as taro-flavored vegetable protein drinks and flowing taro cake. The shelf life and taste of deep-processed products of Lipu taro are improved by modern technology. The two-wheel drive mode of "traditional flavor+modern technology" not only retains the regional characteristics of Lipu taro, but also forms a differentiated product system with technical barriers.

6.2.3 Pay attention to brand building and enhance brand influence

Brand is an important asset of an enterprise and plays an important role in enhancing the added value and market competitiveness of products. Enterprises should pay attention to brand building and improve consumers' awareness and loyalty to products by creating unique brand image and communication strategy. For example, we can enhance the brand's popularity and reputation by holding cultural activities, developing public welfare undertakings and cooperating with well-known brands. At the same time, enterprises should also strengthen the protection of intellectual property rights, avoid the occurrence of infringement and safeguard the legitimate rights and interests of brands.

6.2.4 Strengthen marketing and expand market share

Marketing promotion is an important means for enterprises to expand market share and improve sales performance. Enterprises should formulate scientific and reasonable marketing strategies and make full use of various marketing channels and tools for promotion. For example, brand promotion and product promotion can be carried out through social media, online advertisements and offline activities; Can cooperate with e-commerce platform to carry out online sales; We can cooperate with catering enterprises to introduce products into more consumption scenarios. In addition, enterprises can continuously optimize marketing strategies and improve marketing effects according to market feedback and consumer demand.

6.2.5 Strengthen industrial chain cooperation and achieve coordinated development

Industrial chain cooperation is an effective way to share resources, reduce costs and enhance competitiveness. Enterprises should establish close cooperative relations with upstream and downstream enterprises to jointly promote the industrial development of Lipu taro and modern food. For example, we can establish a long-term and stable cooperative relationship with taro planting base to ensure the quality and supply stability of raw materials; Can cooperate with logistics companies to optimize the logistics distribution system and reduce transportation costs; We can cooperate with scientific research institutions to jointly develop new varieties, new processes and new technologies to enhance the scientific and technological content and added value of products.

6.2.6 Inherit Lipu taro culture and enhance brand value

As a geographical indication product in China, Lipu taro bears a long planting history and regional culture. Enterprises can hold taro culture festival, explore the historical story of "royal tribute", and combine modern design to integrate Zhuang township patterns and ancient cellar-keeping techniques into product packaging and experience scenes. Developing taro carvings to create peripheral and joint-name non-legacy foods, and implanting cultural IP into prefabricated vegetables and deep-processed products not only retain the traditional charm, but also enhance consumers' value recognition of "Lipu Taro" and promote the upgrading of regional agricultural products to cultural brands.

6.2.7 Social responsibility and sustainable development

Adhere to the concept of environmental protection, pay attention to the application of environmental protection concept in product production and packaging design, and reduce the pollution and damage to the environment. Adopt recyclable materials and environmentally friendly packaging to reduce the burden of products on the environment. Strengthen the development of rural revitalization strategy, actively participate in rural revitalization, promote local economic development and increase farmers' income by developing Lipu taro industry, and cooperate with local government to carry out poverty alleviation projects or support farmers to plant high-quality taro to give back to society and achieve sustainable development. Establish corporate culture, establish correct corporate values and cultural concepts, pay attention to employee care and welfare benefits, and enhance employee satisfaction and loyalty. At the same time, actively fulfill corporate social responsibility, participate in public welfare undertakings and charitable activities, and establish a good corporate image and social reputation.

To sum up, in order to highlight the characteristics of Lipu taro in the modern food market and attract more consumers, enterprises need to deeply understand the target market, innovate products, strengthen brand building, and expand market share through diversified marketing strategies. At the same time, work closely with all parties in the industrial chain to jointly promote industrial development. On this basis, we should attach importance to cultural inheritance and environmental protection, actively assume social responsibilities and realize sustainable development. These comprehensive strategies will help enterprises to enhance their competitiveness, win the trust of consumers and promote the prosperity of Lipu taro industry.

COMPETING INTERESTS

The authors have no relevant financial or non-financial interests to disclose.

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