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HEALTHY 'FOOD' IN GOOD, FAT REDUCTION NEW TREND-'HEALTHY LOW-CALORIE DIET' UNDER THE BACKGROUND OF GUANGXI BASED ON THE YOUNG GROUP OF LOW-FAT SNACKS CONSUMPTION INTENTION INVESTIGATION AND INNOVATION STRATEGY ANALYSIS

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Abstract: This paper focuses on the trend of 'low-fat low-calorie healthy diet', aiming at the young group of 14-30 years old in Guangxi, and deeply studies the contradiction between high purchase intention and low purchase rate in the low-fat snack market. On the one hand, we hope to fill the current research gap on low-fat snacks, on the other hand, we hope to bring practical promotion to low-fat snacks. Through questionnaires and network data, this paper analyzes consumer value judgments and reveals the market potential and reform needs of low-fat snacks. Five innovative strategies are summarized: product diversification, customized promotion, multi-channel sales, healthy raw material use and brand vision improvement. Logical model and K-means clustering analysis are used to analyze the influence of consumer characteristics on purchase intention, and the target market is subdivided. A neural network model was established, and 18 specific strategies were proposed, covering product taste, health, channel, marketing and packaging innovation, and quantifying their impact on purchase intention. Finally, it puts forward some suggestions for the development of low-fat snack enterprises with high-quality products and honest marketing as the core, and puts forward some suggestions to the government, hoping to contribute to the healthy development of low-fat snack industry.
Keywords: Low fat low card; Guangxi young consumer groups; Logistic model; K-means clustering analysis; Neural network

1 INTRODUCTION

In today 's society, with the awakening of health awareness and the improvement of living standards, healthy low-calorie diet has become a popular lifestyle, especially among young consumer groups. The young generation not only pursues the taste and nutritional value of food, but also pays more attention to the calories and fat content of food[1]. Therefore, the low-fat and healthy characteristics of low-fat snacks make them an ideal choice to meet the health and delicious needs of young consumers, and low-fat snacks are booming[2].

However, the development of the low-fat snack market is not smooth: the quality and variety of low-fat snacks on the market are uneven. Although some products claim to be low-fat, they may contain other ingredients that are not conducive to health, or are difficult to attract consumers due to poor taste and low nutritional value[3]. This poses a new challenge to low-fat snack companies, that is, how to provide high-quality, good-tasting products while meeting health needs.

In terms of theoretical research, the existing literature has confirmed that the popularity of the concept of healthy low-calorie diet has profoundly affected consumers ' purchase behavior[4], prompting consumers to tend to choose low-calorie, low-fat foods. However, consumers ' diverse needs for food taste, quality and price require companies to consider product innovation and market strategies to adapt to market trends and changes in consumer behavior.

From the perspective of consumer behavior, this study will use the innovative neural network analysis method to focus on the young consumer groups in Guangxi, and deeply explore the consumption willingness of low-fat snacks and its influencing factors under the background of healthy low-calorie diet. The research will not only enrich the theoretical system of healthy diet and provide theoretical support for the development of low-fat snack market, but also provide targeted marketing strategies and product innovation suggestions for low-fat snack enterprises, help enterprises to enhance market competitiveness, and provide reference for the government and relevant departments to formulate healthy diet policies.

In the analysis of market status and network public opinion, the low-fat snack market has great potential, and young consumers have become the main driving force of the market. However, online public opinion has a significant impact on consumers ' shopping decisions, and companies need to pay more attention to the authenticity and transparency of product promotion. In the future, with the improvement of global awareness of healthy eating, the low-fat snack market will usher in a broader development prospect, and enterprises will face challenges and opportunities in product innovation, food safety and sustainable development.

In summary, the purpose of this study is to explore the current situation, challenges and opportunities of the low-fat snack market through an in-depth analysis of the willingness of Guangxi adolescents to consume low-fat snacks, and to

provide theoretical basis and practical guidance for promoting the healthy development of the healthy food industry. In order to achieve a win-win situation for enterprises, consumers and the whole society in the new era of healthy eating.

2 RESEARCH DESIGN

2.1 Research Method Description

(1) Descriptive statistic
Through frequency calculation and graphic drawing, this paper understands and analyzes the distribution of respondents' basic characteristics, their willingness to buy low-fat snacks and their tendency to choose innovative strategies.
(2) K-means clustering analysis
Based on the two dimensions of respondents ' preference for low-fat snacks and purchase frequency, this paper clusters respondents to segment the target population of the market and provide data basis for subsequent in-depth analysis.
(3) Logistic regression
This paper uses Logistic regression model to analyze the influence of basic information of young people in Guangxi on the purchase intention of low-fat snacks, and provides suggestions for low-fat snack merchants and producers.
(4) Neural network
This paper uses neural network model to analyze the impact of different innovation strategies on customer purchase intention, and provides reference for enterprises to predict customer behavior.

2.2 Data Sources and Preprocessing

2.2.1 Data sources

In this paper, a survey was conducted on young consumer groups aged 14-30 in Guangxi. A total of 505 questionnaires were collected, of which 468 were valid, and the effective rate of the questionnaire was about 92.67 %. Through online and offline random sampling of seeds and peer-driven sampling to collect questionnaire data. The specific sampling frame is as follows (Table 1):

Table 1 Sample Boxes Specifically Prepared

Overall stratification	First-level unit sampling frame	Sample city	Secondary unit sampling frame	Sampling urban area	Three-level unit sampling frame
East Guangxi	All cities in eastern Guangxi	Wuzhou city	Wuzhou City (District) Center and Town Street Center	Changzhou region	Some young consumer groups in Changzhou District
		Yulin city	Yulin City (District) Center and Town Street Center	Yuzhou district	Some young consumer groups in Yulin Prefecture
		Hezhou city	Hezhou City (District) Center and Town Street Center	Eight-Step district	Some young consumer groups in the eight-step area
		Qinzhou city	Qinzhou City (District) Center and Town Street Center	Qinnan district	Some young consumer groups in Qinnan District
Southern Guangxi	All Cities in Southern Guangxi	Chongzuo city	Chongzuo City (District) Center and Town Street Center	Jiangzhou district	Some young consumer groups in Jiangzhou District
		Fangchenggang city	Fangchenggang City (District) Center and Town Street Center	Fangchenggang district	Some young consumer groups in Fangcheng District
		Beihai city	Beihai City (District) Center and Town Street Center	Haicheng district	Some young consumer groups in Haicheng District
		Hechi city	Hechi City (District) Center and Town Street Center	Jinjiang City district	Some young consumer groups in Jinjiang City District
West Guangxi	All cities in western Guangxi	Baise city	Baise City (District) Center and Town Street Center	Youjiang district	Some young consumer groups in Youjiang District
Northern Guangxi	All cities in northern Guangxi	Guilin city	Guilin City (District) Center and Town Street Center	Lingui district, Xiufeng district	Some young consumer groups in Lingui District and Xiufeng District
		Laibin city	Laibin City (District)	Xingbin district	Some young consumer

			Center and Town Street Center		groups in Xingbin District
		Liuzhou city	Liuzhou City (District) Center and Town Street Center	Liubei district, Chengzhong district	Some young consumer groups in Liubei District and Chengzhong District
Central region of Guangxi	All Cities in Central Guangxi	Nanning city	Nanning City (District) Center and Town Street Center	Xingning district, Qingxiu district	Some young consumer groups in Xingning District and Qingxiu District
		Guigang city	Guigang City (District) Center and Town Street Center	Guigang North district	Some young consumer groups in northern Guangxi

2.2.2 Pre-survey and reliability and validity test

In this pre-survey, 110 questionnaires were randomly distributed to young consumers in 8 cities in the sampling frame. Finally, 96 valid questionnaires were collected, and then the reliability and validity of the questionnaire data were tested to find out the problems.

(1) Reliability test

The reliability test was performed by SPSS software. The results are as follows (Table 2):

Table 2 Reliability Statistics

Cronbach's Alpha	Number of items
0.841	37

The data results show that the overall reliability of the questionnaire is 0.859 greater than 0.80, indicating that the answer to the questionnaire is more reliable.

(2) Validity test

In this paper, KMO and Bartlett spherical test are used to test the structural validity of the questionnaire data through SPSS software. The correlation coefficient of all variables is close to 1, and the correlation between variables is strong. The larger the test value of Bartlett spherical test, the higher the independence between variables, and the more suitable for factor analysis. Before conducting factor analysis, this paper first conducts a sampling adequacy test (Kaiser-Meyer-Olkin, KMO) and Bartlett spherical test to determine the feasibility and rationality of the implementation of factor analysis[5]. Using SPSS software to test the validity, the results are as follows:

Table 3 KMO and Bartlett Spherical Test

KMO and Bartlett tests		
KMO sampling suitability quantity		0.704
Bartlett sphericity test	Approximate chi-square	1653.652
	Degree of freedom	595
	Significance	0.000

Like Table 3, the KMO coefficient is 0.704, and the P-value is approximately 0.000, indicating that it is suitable for factor analysis.

(3) factor analysis

In order to facilitate the subsequent factor analysis, this paper summarizes the following 12 questions in the second part of the questionnaire into three dimensions, which are named as favorability (a1-a2), purchase intention (b3-b7) and strategic preference (c8-c12), like Table 4.

Table 4 Correspondence Table of Variables

Variable name	Corresponding to the questionnaire questions
Favorability a1	8.What is your preference for low-fat snacks?
Favorability a2	14.When low-fat snacks are innovated in all aspects, will you choose to buy?
Purchase intention b3	18. Will you buy low-fat snacks after product innovation?
Purchase intention b4	20. Will you buy low-fat snacks with innovative sales channels?
Purchase intention b5	22.Will you buy low-fat snacks after marketing innovation?
Purchase intention b6	24. Will you buy low-fat snacks with innovative packaging and logo?
Purchase intention b7	26. Will you buy low-fat snacks that are innovative in terms of health?

Strategy preference c8	17.What do you like about product innovation of low-fat snacks?
Strategy preference c9	19.What do you like about the innovation of sales channels for low-fat snacks?
Strategy preference c10	21.What do you like about innovative marketing ideas for low-fat snacks?
Strategy preference c11	23.What do you like about the innovation of packaging and logo of low-fat snacks?
Strategy preference c12	25. What are your favorite health innovations for low-fat snacks?

Factor analysis was performed on the second part of the questionnaire. The questionnaire with structural validity should meet the following two conditions:
1) The common factor should be consistent with the composition of the structural hypothesis in the questionnaire design, and the cumulative variance contribution rate of the common factor should be at least 40 %.
2) Each problem has a higher load value (greater than 0.4) on one of the common factors, and a lower load value on the other common factors. If a problem has a low load value on all factors, it indicates that the meaning it reflects is not clear and should be changed or deleted.

Table 5 Variance Interpretation Table

Total variance explanation

Component	Initial eigenvalue			Extract the load sum of squares		
	Grand total	Variance proportion	Cumulative %	Grand total	Variance proportion	Cumulative %
1	6.541	18.689	18.689	6.541	18.689	18.689
2	3.495	9.985	28.674	3.495	9.985	28.674
3	2.596	7.418	36.092	2.596	7.418	36.092
4	2.302	6.578	42.670	2.302	6.578	42.670
5	1.997	5.707	48.377			
6	1.664	4.755	53.132			
7	1.453	4.150	57.282			
8	1.278	3.650	60.932			
9	1.121	3.202	64.134			
10	1.085	3.099	67.234			
11	0.976	2.789	70.022			
12	0.935	2.672	72.694			
13	0.881	2.516	75.210			
14	0.856	2.446	77.656			
15	0.713	2.036	79.692			
16	0.680	1.943	81.635			
17	0.653	1.865	83.501			
18	0.594	1.698	85.199			
19	0.566	1.618	86.817			
20	0.527	1.506	88.323			
21	0.458	1.309	89.632			
22	0.443	1.266	90.898			
23	0.394	1.125	92.023			
24	0.359	1.027	93.050			
25	0.335	0.956	94.006			
26	0.326	0.931	94.937			
27	0.318	0.910	95.846			
28	0.261	0.747	96.593			
29	0.222	0.634	97.227			
30	0.220	0.629	97.856			
31	0.184	0.525	98.380			
32	0.166	0.475	98.856			
33	0.150	0.429	99.285			
34	0.131	0.375	99.659			
35	0.119	0.341	100.000			

Extraction method: principal component analysis

Like Table 5, a total of 4 common factors were extracted. The explained variance of the first 5 common factors was 42.670 %, which met the requirement that the variance contribution rate should be higher than 40 %. After factor rotation, the variance contribution rate of each new common factor changed, but the final cumulative variance contribution rate remained unchanged.

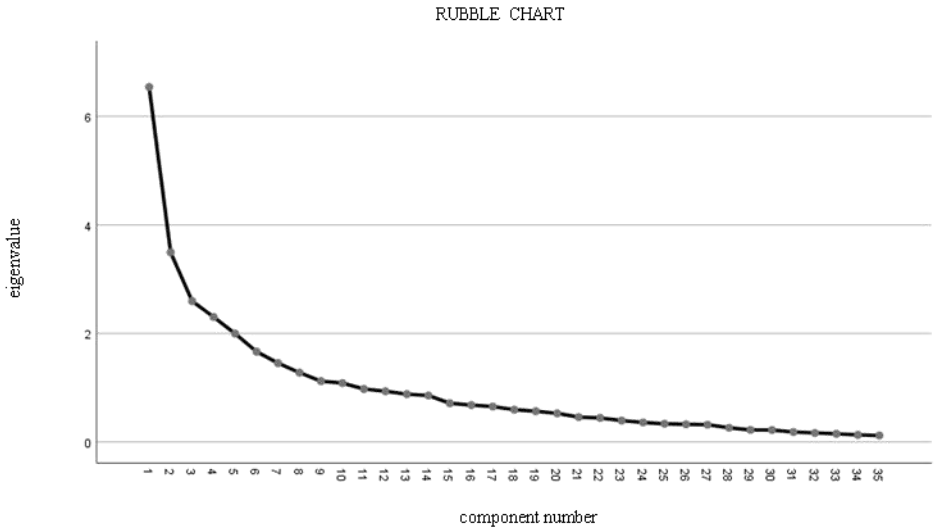

Figure 1 Initial Eigenvalue Gravel Diagram

Like Figure 1, the eigenvalues are arranged in descending order, and the slope between the number of factors 4 and the number of factors 5 becomes slower. The first four factors can already cover most of the information, so the number of factors can be selected as 4, that is, the 12 problems are classified into 4 categories.

Table 6 Rotated Component Matrix

Component matrix a				
	Component			
	1	2	3	4
Favorability a1	-0.157	0.175	0.355	0.431
favorability a2	-0.430	0.029	0.036	0.243
Strategy preference c8	0.107	0.286	-0.367	-0.257
Strategy preference c8	0.142	0.463	0.212	0.183
Strategy preference c8	0.399	0.203	-0.211	0.112
Strategy preference c8	-0.263	0.207	0.659	-0.310
Purchase intention b3	-0.608	-0.101	-0.145	-0.025
Strategy preference c9	0.259	0.602	-0.034	-0.062
Strategy preference c9	0.360	0.407	-0.022	0.058
Strategy preference c9	0.104	0.420	0.024	0.286
Strategy preference c9	0.322	0.450	0.118	0.047
Strategy preference c9	0.229	0.251	0.375	-0.320
Strategy preference c9	-0.572	0.075	0.521	-0.322
Purchase intention b4	-0.634	-0.194	-0.163	-0.101
Strategy preference c10	0.230	0.395	-0.112	-0.389
Strategy preference c10	0.393	0.385	-0.181	0.178
Strategy preference c10	0.370	0.338	0.051	0.005
Strategy preference c10	0.232	0.422	0.182	0.028
Strategy preference c10	-0.491	0.038	0.603	-0.215
Purchase intention b5	-0.558	-0.107	0.046	0.328
Strategy preference c11	0.322	0.387	-0.170	0.026
Strategy preference c11	0.318	0.394	0.036	0.032
Strategy preference c11	0.413	0.358	0.026	-0.111
Strategy preference c11	-0.417	0.296	0.574	-0.091
Purchase intention b6	-0.489	-0.087	0.016	0.358
Strategy preference c12	0.609	-0.315	0.279	0.361
Strategy preference c12	0.511	-0.281	0.337	0.414
Strategy preference c12	0.437	-0.320	0.073	-0.440
Strategy preference c12	0.625	-0.360	0.034	-0.002
Strategy preference c12	0.493	-0.387	-0.062	-0.223
Purchase intention b7	0.595	-0.246	0.295	0.332
Purchase intention b7	0.495	-0.214	0.392	0.339
Purchase intention b7	0.417	-0.279	0.161	-0.365
Purchase intention b7	0.530	-0.290	0.231	-0.116
Purchase intention b7	0.598	-0.306	0.080	-0.369

extraction method: principal component analysis.
a. four components were extracted.

Like Table 6, b7 and c12 variables in factor 1 are relatively large, the load values of c9 ~ c11 variables in factor 2 are relatively large, the load values of b8 variables in factor 3 are relatively large, and the load values of the first six variables in factor 4 are relatively large, indicating that the correlation between variables and their corresponding factors is high. It can be seen that the definition of the factor is clear, which can better represent the meaning of the variable it contains.

3 DESCRIPTIVE ANALYSIS OF THE CURRENT SITUATION OF LOW-FAT SNACKS MARKET

3.1 Analysis of Interviewee Characteristics and Purchase Behavior

After descriptive statistical analysis of the data, it was found that the age of the respondents was mainly between 19 and 23 years old, accounting for more than 50 %, indicating that the young group paid more attention to low-fat snacks. The high proportion of female respondents, nearly two-thirds of the total sample, may be related to the fact that women are more concerned about health and weight management[6]. In terms of education distribution, the proportion of respondents with bachelor 's degree or below (excluding bachelor 's degree) is less than 45 %, which indicates that young consumers with higher education have more understanding and demand for low-fat snacks. In terms of employment, most of the respondents are students, which is consistent with the characteristics of age distribution. The monthly consumption level is mainly concentrated in the range of 1000-2000 yuan, reflecting the economic strength and consumption ability of young consumer groups[7]. The following table shows (Table 7):

Table 7 Respondent Basic Information and Its Proportion

essential information	age	sexuality	employment status	record of formal schooling	monthly consumption level
specific information	19-23 years	female	students in reading	regular college course	1000-2000 yuan
proportion	50.30%	62.77%	64.36%	55.45%	48.51%

In terms of purchase behavior, respondents generally have a high preference for low-fat snacks, but the actual purchase frequency is relatively low, as shown in Figure 2 and Figure 3. This shows that although low-fat snacks have a certain market recognition in the young group, there are still some obstacles to translate into actual purchase behavior. Further analysis found that price, taste and health are the main factors affecting purchase behavior. Most respondents said that if low-fat snacks can provide better taste and reasonable prices while maintaining health, they will be more willing to buy.

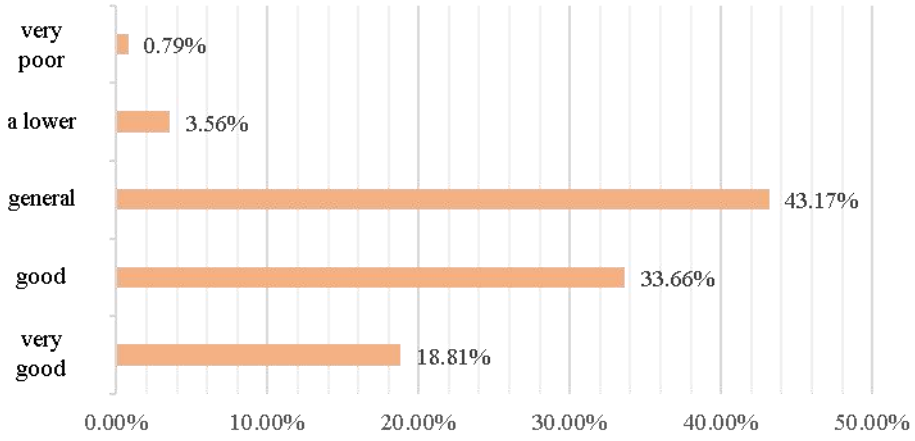

Figure 2 Low-Calorie Snacks Favorability Distribution Map

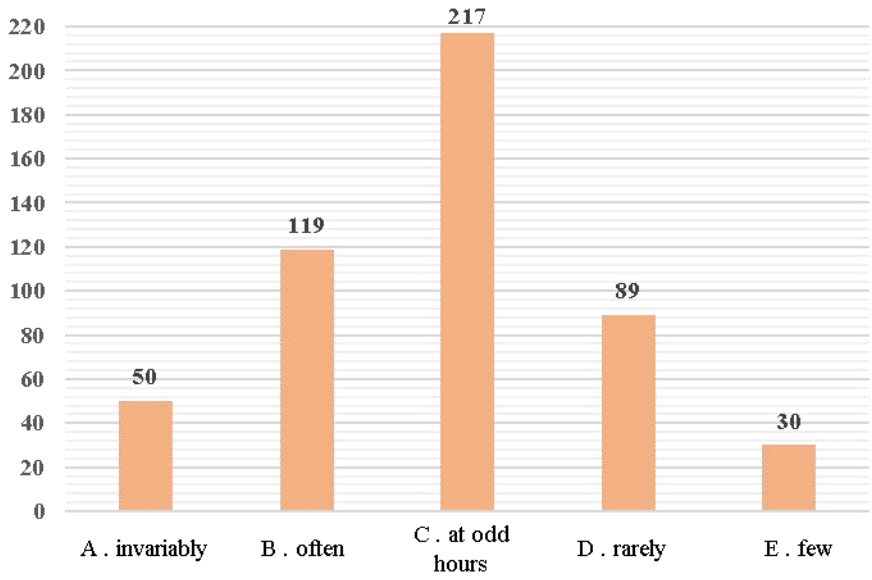

Figure 3 Interviewee Purchase Frequency Chart

3.2 Correlation Analysis between Respondents and Purchase Rate

Original hypothesis H_0: the impact of respondents' basic information on whether to buy low-fat snacks is not significant.
In order to verify this hypothesis, this paper tests the correlation between the basic information of the respondents (such as age, gender, education, etc.) and the purchase rate. Through chi-square test, t test and other statistical methods, it is found that there is a certain correlation between age and gender and purchase rate. As Table 8 shows, young women aged 19-23 are more likely to buy low-fat snacks. The level of education also showed a positive correlation with the purchase rate, and respondents with bachelor's degree were more likely to buy low-fat snacks.

Table 8 Chi-square Test Results

essential information	chi-square value	P	significance
sexuality	-0.072	***	significant
age	2.777	***	significant
record of formal schooling	1.265	***	significant
employment status	2.6	***	significant
monthly consumption level	1.304	0.171	non-significant
city of residence	5.320	0.102	non-significant
BIM	3.135	0.057	non-significant
*p<0.05 **p<0.01 ***p<0.001			

In summary, gender, age, education, employment situation passed the test at a significant level of 5 %, and the basic information of respondents had a certain significant impact on the purchase of low-fat snacks.

4 ANALYSIS OF PURCHASE INTENTION

4.1 Analysis of the influence of customer characteristics on purchase intention based on Logistic regression

This paper uses Logistic model to quantitatively analyze the influence of seven basic information characteristics of young consumers, such as age, gender and education background, on the purchase intention of low-fat snacks after innovation, and puts forward suggestions on product positioning and target market feature selection.

4.1.1 Modeling

In this study, Logistics regression model was used to analyze the influencing factors of young people 's willingness to purchase low-fat snacks after innovation. Age, education and other types of variables using dummy variable processing method[8-9]. 1 means to choose an option, 0 means no choice, and it is included in the model for Logistic regression. The results are shown in Table 9.

Table 9 The Letters of Each Variable Represent the Result

Independent variable letter representation	Chinese meaning of independent variable
Age1	14-18 years old
Age2	19-23 years old

Age3	24-28 years old
Age4	Age: 28 +
Sex1	male
Sex2	female
Edu1	primary school and below
Edu2	junior high
Edu3	high School (including Secondary)
Edu4	college for professional training
Edu5	regular college course
Edu6	postgraduate and above
Job1	Employment situation: students in school
Job2	Employment situation: employed
Job3	Employment situation: other
Con1	Monthly consumption level: 0-1000 yuan
Con2	Monthly consumption level: 1000-2000 yuan
Con3	Monthly consumption level: 2000-4000 yuan
Con4	Monthly consumption level: 4000-6000 yuan
Con5	Monthly consumption level: 6000 yuan or more
City1	Inhabited city: Eastern Guangxi
City2	Inhabited city: Southern Guangxi
City3	Inhabited city: Western Guangxi
City4	Inhabited city: Northern Guangxi
City5	Inhabited city: Central Guangxi
BMI1	BMI ≤ 18.5 (light weight)
BMI2	18.5 ≤ BMI < 24 (healthy weight)
BMI3	24 ≤ BMI < 28 (overweight)
BMI4	BMI ≥ 28 (obesity)

4.1.2 Model application

Table 10 Logistic Regression Model Results

variable	B (standardized coefficient)	standard error	significance	VIF
Age1	0.031	0.037	0.048	2.089
Edu5	0.182	0.113	0.006	0.339
Job1	0.071	0.061	0.030	1.015
Con2	-0.168	0.122	0.041	0.497
City4	-0.003	0.121	0.002	1.001
City5	-0.005	0.286	0.002	0.000
BMI2	0.856	0.844	0.031	1.029

In this study, Age2, Edu5, Job1, Con2, City4, City5 and BMI2 were selected as the benchmark categories, that is, 19-23 years old, undergraduate education, school students, monthly consumption level of 1000-2000 yuan, living in cities in northern and central Guangxi, BIM value 18.5 ⩽ BIM < 24. Six variables of age, education level, employment situation, monthly consumption level, living city and BIM value are selected into the model. After Logistic regression, the significance level values of 6 variables such as age and education level were less than 0.05, indicating that the coefficient was statistically significant and statistically significant. The regression results are shown in Table 10.

According to the results in the table, the Logistic regression model is as follows:

$$\mathrm{p}(y) = \frac{1}{1+e^{-x}} \tag{1}$$

$$\mathrm{x} = 0.031\mathrm{Age1} + 0.182\mathrm{Edu5} + 0.071\mathrm{Job1} - 0.168\mathrm{Con2} - 0.003\mathrm{City4} - 0.005\mathrm{City5} + 0.856\mathrm{BMI2} \tag{2}$$

Among them, y represents the willingness to buy, y = 1 represents the willingness to buy low-fat snacks after marketing strategy innovation, and y = 0 represents the unwillingness to buy low-fat snacks after innovation.

The predictive ability of the scoring tool was tested by the area under the receiver operating characteristic (ROC) curve[10]. If the area under the curve is greater than 0.7, the discrimination of the scoring tool is greater (Table 11).

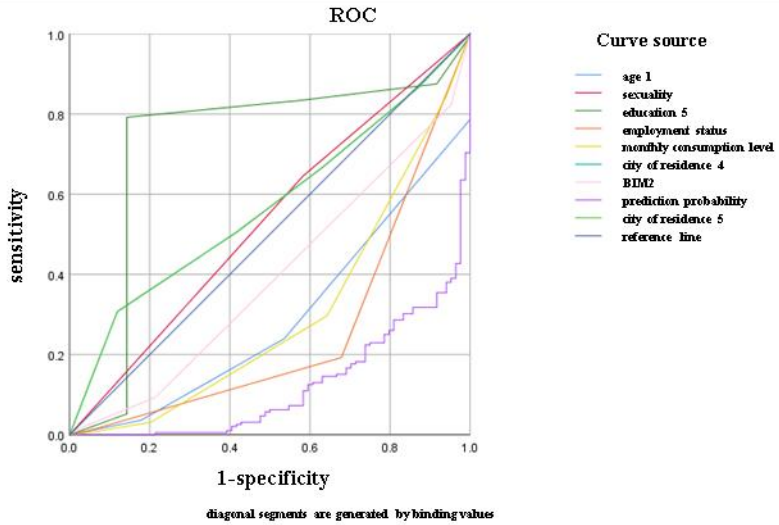

Figure 4 Receiver-Operating Characteristiccurve

Table 11 The Region Table below The Curve

The area below the curve					
Test result variables	Area	STDERR	Significance	Asymptotic 95 % confidence interval	
				Lower bound	Upper bound
Age1	0.291	0.033	0.000	0.227	0.355
Sex	0.531	0.038	0.409	0.457	0.606
Edu5	0.725	0.038	0.000	0.651	0.799
Job1	0.256	0.034	0.000	0.189	0.323
Con 2	0.300	0.035	0.000	0.231	0.369
City4	0.569	0.035	0.068	0.500	0.639
BIM2	0.392	0.036	0.004	0.321	0.463
Prediction probability	0.122	0.021	0.000	0.081	0.162
City5	0.569	0.035	0.068	0.500	0.639

The maximum number of regions below the ROC curve is 0.725, which is greater than 0.7, so the model has greater discrimination (Table 12).

Table 12 Omnibus Test of Model Coefficients

	chi-square	significance
procedure	125.662	0.000
Model Block	125.662	0.000
model	125.662	0.000

Table 13 Hosmer-Lemeshaw Test

procedure	chi-square	degree of freedom	significance
1	12.337	7	0.090

Because R2 is equal to 0.690, the fitting effect is better; the P value of the Omnibus test model was 0.000, less than 0.05. In summary, the Logistic model as a whole is statistically significant. As shown in Table 13, the significance level of the Hosmer-Lemeschau test is equal to 0.090, greater than 0.05. It shows that the information in the data has been fully extracted, there is no significant difference between the predicted value and the observed value, and the model fitting degree is good. As shown in Table 14, the classification prediction accuracy of the Logistic regression model is 72.5 %, the accuracy is high, and the model effect is good.

Table 14 Partial Results of Logistic Test

variable	significance
age	***
sexuality	***
record of formal schooling	***
employment status	***
Monthly consumption level	0.171
City of residence	0.102
BMI value	0.057
*p<0.05 **p<0.01 ***p<0.001	

(1) Significant factors: Age significantly affects young people 's willingness to buy innovative low-fat snacks, and respondents aged 19-23 showed the highest interest. Gender also played a role, as female respondents were twice as likely to buy innovative low-fat snacks than men, possibly due to greater emphasis on diet management. Education is another significant factor, and 63.44 % of the respondents who are willing to buy such snacks are undergraduates, indicating that respondents with bachelor 's degree are more inclined to buy. Employment status significantly affected purchase intention, and students showed the strongest purchase intention, indicating that they prioritized healthy and innovative low-fat snacks.
(2) Non-significant influencing factors: monthly consumption level ($P > 0.05$) had no significant effect on the willingness to purchase innovative low-fat snacks, because consumers were willing to pay a reasonable price for healthy choices after the epidemic[11]. The city of residence ($P > 0.05$) also had no significant effect on purchase intention, which may be due to the common interest in healthy eating in different cities. Height and body mass index (BMI) ($P > 0.05$) were also not significant, because increased awareness of healthy eating weakened its impact on low-fat snack purchase intention.

4.2 Strategy Analysis of Different Customer Groups Based on K-means

4.2.1 K-means crowd clustering

This paper uses the cluster analysis of user response to create consumer portraits, and provides help for the strategic innovation of low-fat snacks for different groups. By simplifying the analysis dimension and enhancing the readability of the results, it lays a foundation for in-depth exploration of different customer segments.
(1) The theoretical basis of crowd classification: K-means algorithm measures the similarity within the group based on the distance from the center of the group. It first selects an initial number of groups (k), and assigns sample points to the nearest center, iteratively updates the center until it reaches stability. This study will also adjust the RFM model that evaluates customer value through recent, frequency and monetary indicators to the LFM model that incorporates Likeness in order to make a more relevant analysis of low-fat snack preferences. The adjusted model helps to identify the value orientation of different customer groups and formulate corresponding marketing strategies. [12]
(2) Variable selection: The analysis considered three variables, preference for low-fat snacks, purchase frequency, and consumption budget. The 'favorability' is measured based on a scale from 'very good' to 'very poor', while the purchase frequency is from 'always' to 'almost no'. The purchase price is evaluated according to the ratio of '21 yuan or more' to '0 ~ 10 yuan'. These variables together assess customer value.
(3) Result analysis: The iterative results of SPSS show that the results after four iterations are stable, so four consumer groups are determined according to the degree of favorability, purchase frequency and price:
Active customers: Advocates of high favorability, frequency and price loyalty of low-fat snacks with significant market value.
Developmental customers: have higher affinity, average frequency and higher price key growth targets because they have strong potential.
Potential customers: generally favorable degree and frequency, low price challenge conversion, but with the potential for improvement.
Silent customers: General favorability, low frequency, low price-high switching costs and low market value, representing the lowest priority of the brand.
The data showed that 52.47 % of the respondents were in favor of low-fat snacks, and the silent customers had the highest approval of low-fat snacks, which was 95.2 %. This shows that there is a huge market potential among young consumers, highlighting the need for brands to transform goodwill into purchase behavior through innovative marketing strategies (Table 15-20).

Table 15 RFM Model Customer Classification Standard Table

customer type	numbering	feature
general value	111	Consumption time is not far, consumption frequency and consumption amount of medium level.
General developing	110	Consumption time is not far, the amount of consumption is general, the frequency is not high, can be excavated.
Generally keep	011	The consumption time is far away, but the consumption frequency and amount are OK, and there is the possibility of awakening.
General retention	001	Consumption time is far away, consumption frequency is not high, have a certain consumption ability, should be given to retain measures.
important values	222	The recent consumption time, consumption frequency and consumption amount are very high.
Important to develop	202	Recent consumption time is close, the amount of consumption is high, but the frequency is not high, loyalty is not high, very potential users, we must focus on development.
Important to maintain	022	The recent consumption time is far away, but the consumption frequency and amount are high, indicating that this is a loyal customer who has not come for a period of time. This study needs to take the initiative to keep in touch with him.

Important Retention	002	Recently, users with long consumption time and low consumption frequency, but high consumption amount, may be users who will be lost or have been lost, and should be given retention measures.

Table 16 Cluster Variable Summary Table

Dependent variable	The questionnaire number and questionnaire questions involved
favorability	8.What is your preference for low-fat snacks?
purchase frequency	9.What is the frequency of your purchase of low-fat snacks?
purchase price	12. Which price range do you prefer to buy low-fat snacks?

Table 17 Cluster Analysis Result

Iteration	Changes in cluster centers			
	1	2	3	4
1	1.805	1.987	1.592	1.113
2	0.826	0.038	0.592	0.000
3	0.207	0.144	0.110	0.283
4	0.179	0.016	0.000	0.567
5	0.000	0.000	0.000	0.000

Table 18 Cluster Analysis Result

Number of cases in each cluster		
cluster	1	107.000
	2	129.000
	3	201.000
	4	31.000
effectiveness		468.000
deficiency		0.000

Table 19 Group Categorical Features

Naming	A: active customer	B: developmental customer	C: potential customer	D: silent customers
favorability	high frequency (3 points)	high frequency (3 points)	general frequency (1 point)	general frequency (1 point)
purchase frequency	high frequency (5 points)	general frequency (3 points)	general frequency (3 point)	low frequency (1 point)
fraction	8 points	6 points	4 points	1 point
Number of cases	3	3	16	446

Table 20 The Distribution of Respondents' Preference for Low-Fat Snacks

option	subtotal	proportion
A. very good	95	18.81%
B. good	170	33.66%
C. general	218	43.17%
D. lower	18	3.56%
E. very poor	4	0.79%
This topic effectively fill in the number of people	505	100%

4.2.2 Different types of customers' choice of five innovation strategies

This paper analyzes how consumers' different preferences in taste, marketing, sales, packaging and health concepts affect the purchase decision of low-fat snacks, and puts forward strategic reform suggestions for enterprises to target different types of customers. Figure 5 shows that silent customers prioritize product tastes, marketing methods, sales channels, packaging, and health concepts, making their transition to active customers challenging. On the contrary, active customers show a stronger desire to buy due to their focus on health, which indicates a higher sensitivity to product health. The other two customer types are more emphasis on taste and sales channels, which indicates that they are easier to switch. Therefore, in order to successfully transform customer types, merchants should give priority to diversifying product tastes, expanding sales channels, enhancing online sales, and developing healthier options to retain active customers.

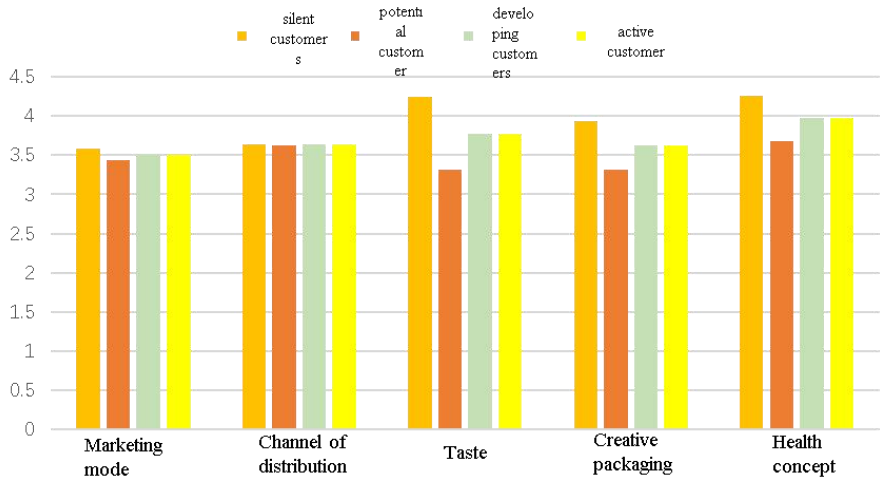

Figure 5 Each type of customer 's score on each innovation strategy (average score)

4.2.3 Preferences of different customer groups for specific ways of each strategy

(1) Innovative marketing ideas

Figure 6 shows that silent, potential and developing customers show a strong interest in sponsoring film and television programs, co-branding with IP, and engaging users in design marketing, reflecting their desire for product awareness and enhanced consumer experience. Active customers also give priority to product awareness, and nearly 100 % of active customers support IP joint marketing. Using well-known online IP for joint marketing can significantly enhance brand influence and sales. Therefore, low-fat snack enterprises should formulate corresponding marketing strategies according to the preferences of different customer groups.

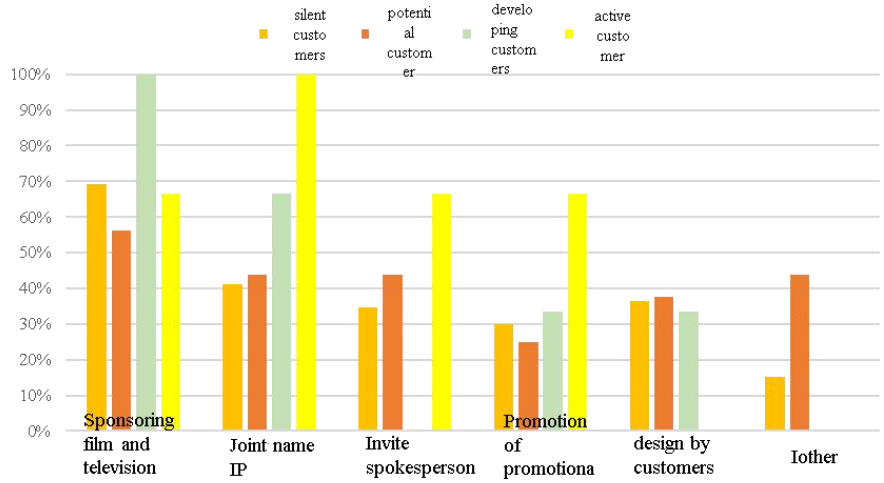

Figure 6 The love of different customer types for different marketing ideas

(2) Sale-channel innovation

Figure 7 shows that silent customers prefer offline experience stores and self-service vending machines, with preferences of 83.4 % and 69.2 % respectively. Potential customers also favor self-service vending machines (62.5 %), while development customers tend to shop online. All three groups seek greater purchase convenience and enhanced shopping experience. Active customers have less change in channel preference, which may be due to their frequent purchases.

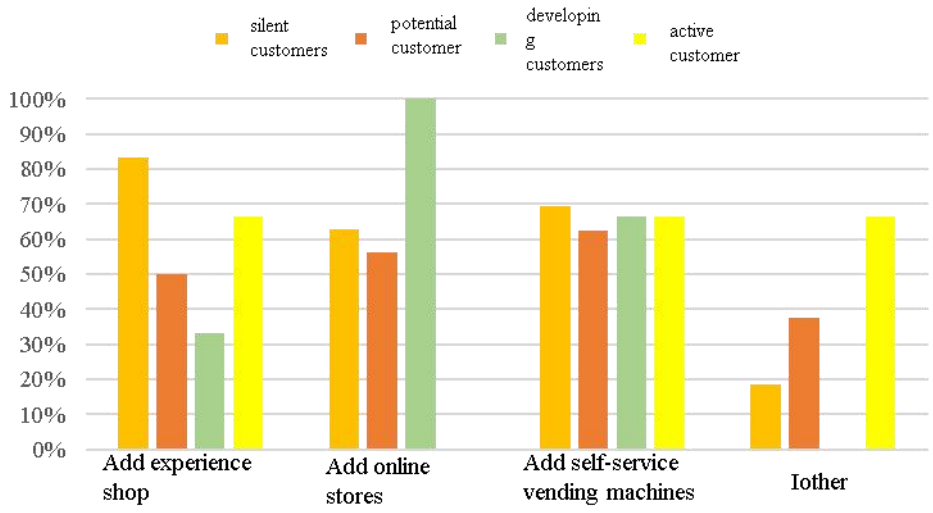

Figure 7 The love of different customer types for different sales channels

(3) Product packaging innovation

Figure 8 shows that customers give priority to environmentally friendly packaging, cover design, packaging and logo, indicating a preference for unique and trendy design. Active customers mainly focus on cover design, while other types of customers also value environmental considerations in packaging.

Figure 9 emphasizes that all four customer types give priority to health in low-fat snacks ; for example, 86.54 % of active customers prefer products with low preservative content and rich in healthy ingredients. Given the long shelf life of snacks, consumers expect fewer preservatives, prompting companies to focus on health by developing healthier options.

Figure 10 illustrates the common trend of all customer groups regarding the type and taste of low-fat snacks. For example, developing customers prefer tastes closer to traditional snacks and a wider range of products, which indicates important problems in the current market, such as limited variety and poor taste compared to traditional snacks. In order to compete, low-fat snack companies must diversify their products and invest in new technologies or better fat substitutes to improve taste, as poor flavors seriously hinder consumers' repurchase rates.

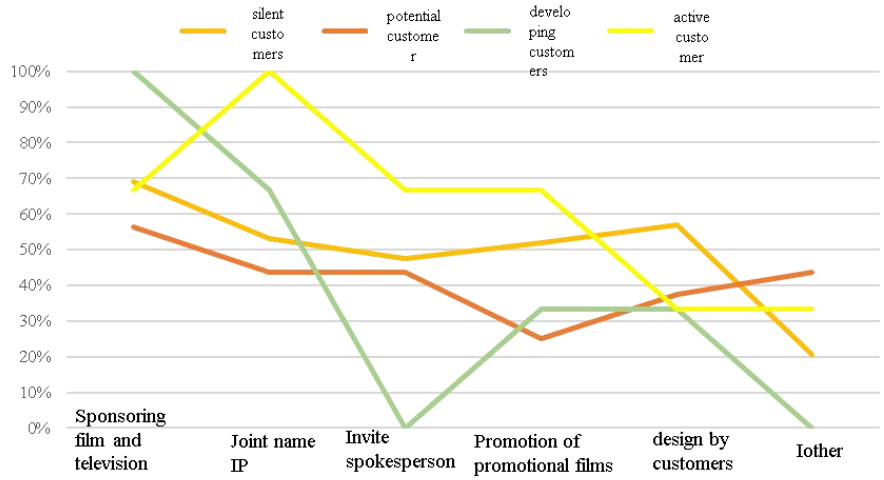

Figure 8 The Preference of Different Customer Types for Different Packaging Innovation Methods

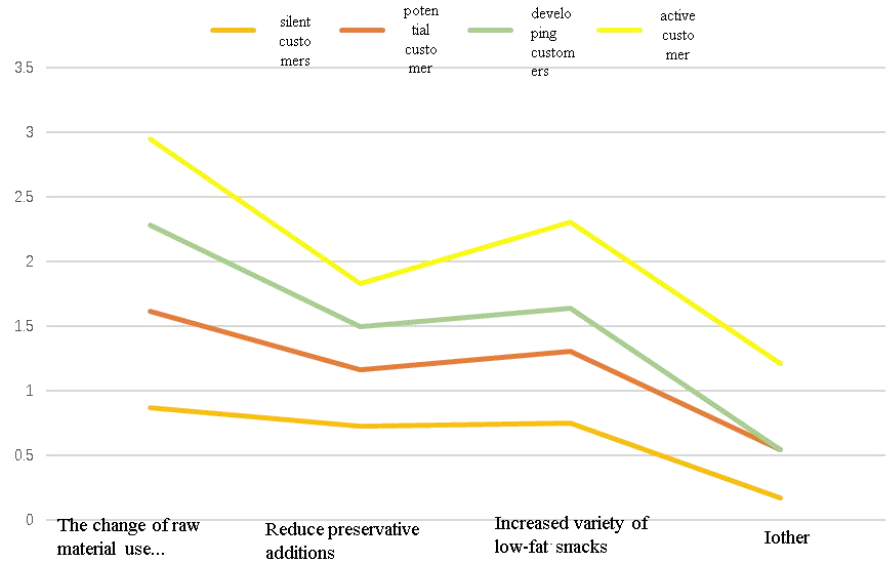

Figure 9 The Preference of Different Customer Types for Different Health Concept Innovation Methods

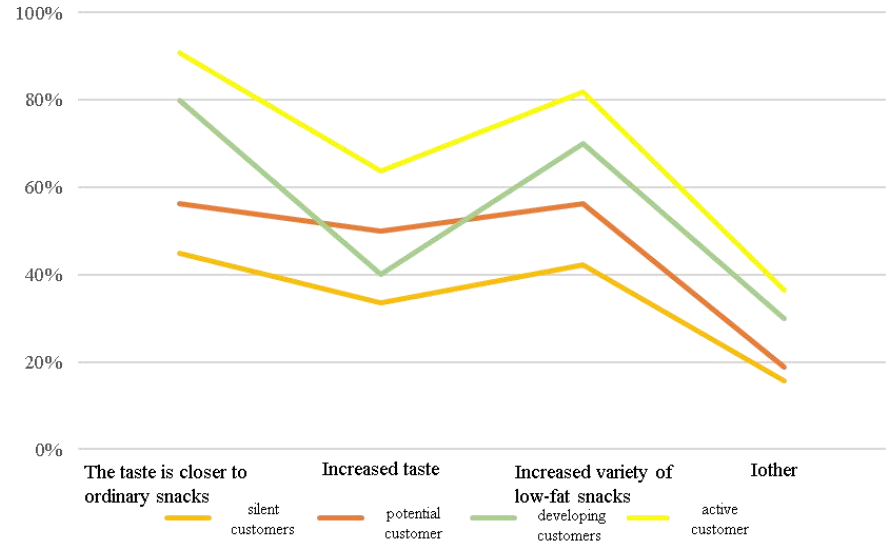

Figure 10 The Preference of Different Customer Types for Different Taste Innovation Methods

5 BASED ON THE NEURAL NETWORK MODEL, THE INFLUENCE OF INNOVATION STRATEGY ON PURCHASE INTENTION IS ANALYZED

5.1 Model overview

The neural network model imitates the structure and function of the human brain to perform tasks such as classification and clustering. It includes input layer, hidden layer and output layer. The input layer receives external data, passes it to the hidden layer for processing, and then passes it to the output layer for prediction. In this study, a multi-layer feedforward neural network with back propagation is used to train the model efficiently[13].

5.2 Modelling

A neural network model was constructed to analyze the influence of 18 specific strategies on the purchase intention of low-fat snacks among young consumers in Guangxi. The dependent variable of the model is the purchase intention, and the independent variable is the improvement strategy. The data is divided into training set and test set for model construction, training, testing and application (Table 11-12).

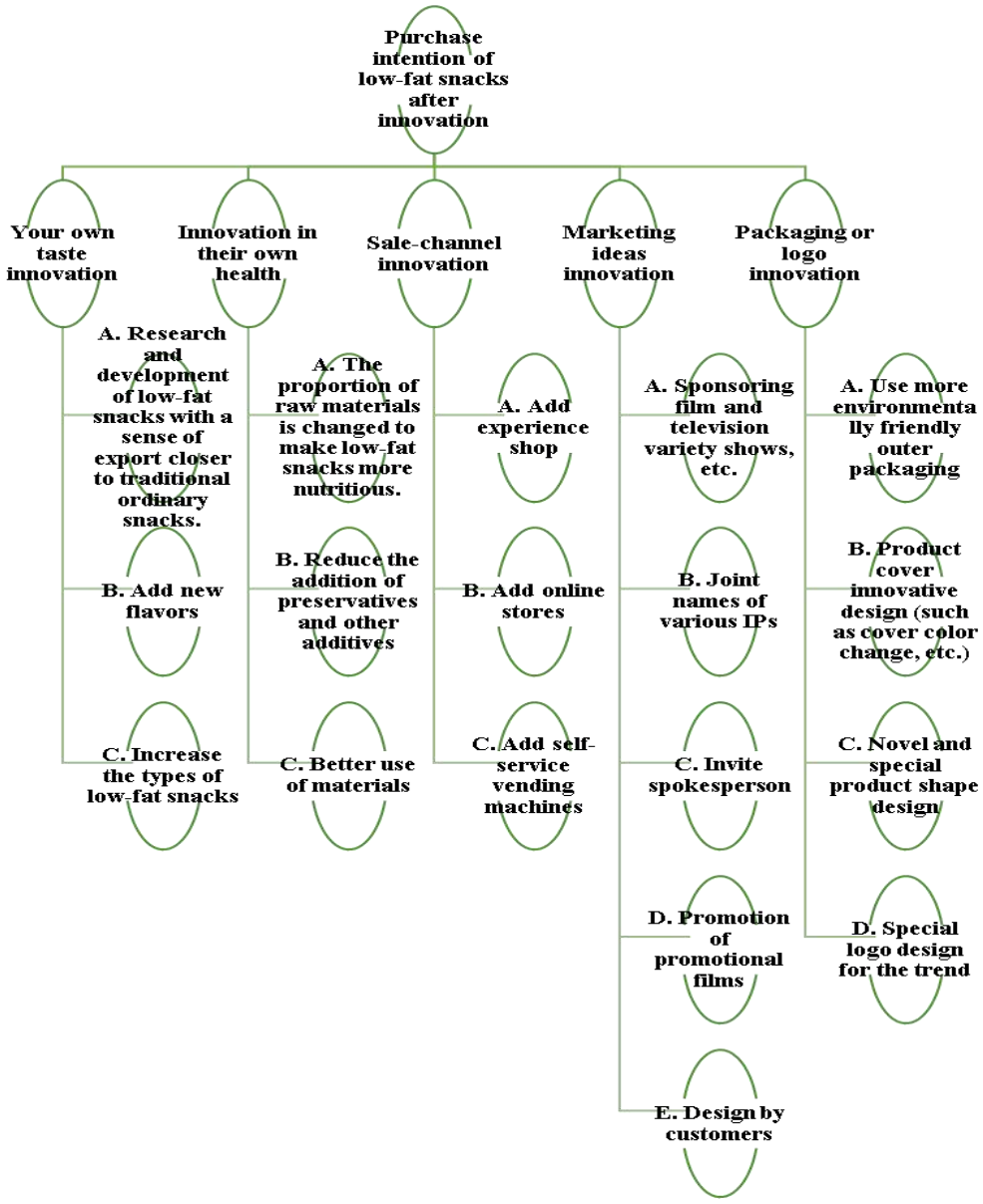

Figure 11 Factors Affecting the Purchase of Innovative Sugar Free Beverages

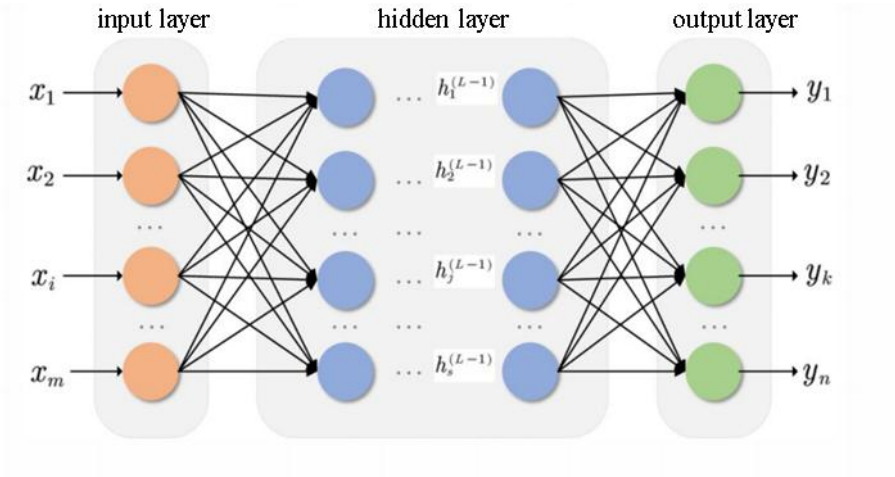

Figure 12 Neural Network Model Structure

5.3 The Influence of Low-Fat Snack Innovation Strategy on Purchase Intention

The importance of different strategies is determined by shuffling feature columns and predicting loss values. It was found that strategies such as 'inviting spokespersons' and 'promoting promotional videos' were found to be more important, which is consistent with the trend-seeking behavior of young consumers (Table 13).

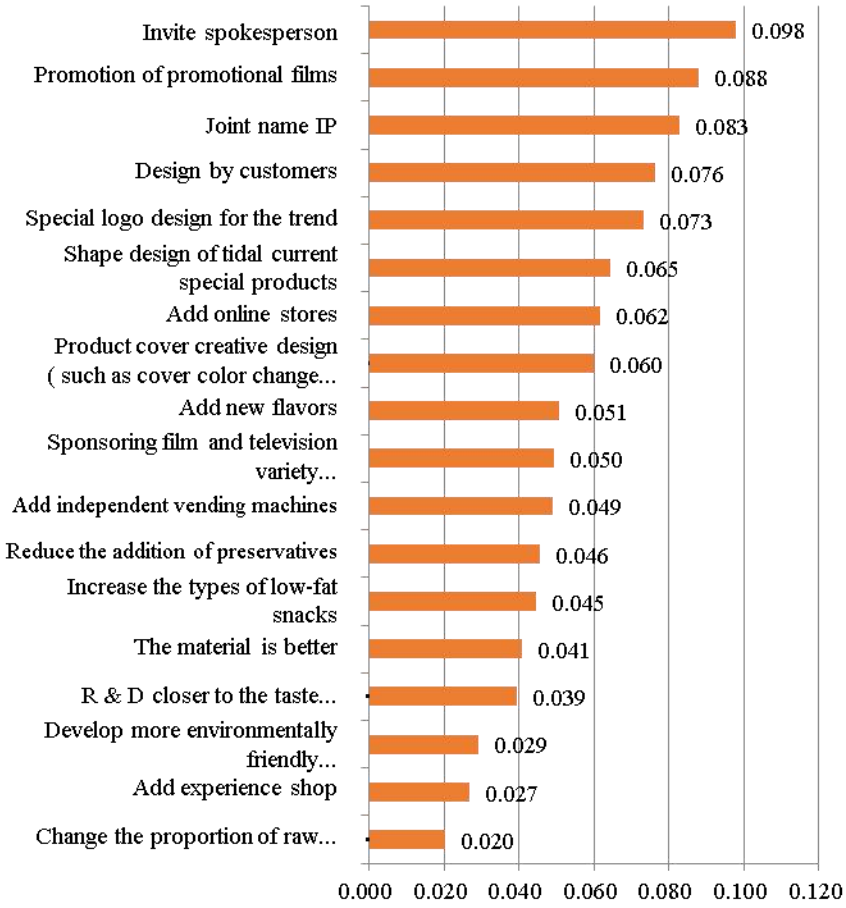

Figure 13 The Order of Importance of Factors Affecting Purchase Intention

6 CONCLUSION AND SUGGESTION

6.1 Conclusion

(1) Enterprise perspective
Online sentiment analysis shows that low-fat snacks are very popular among young consumers, showing growth opportunities under the trend of healthy eating after the COVID-19 epidemic. Although individuals aged 14 to 30 do not often buy these snacks, they are very open to innovative options and show great potential for development[14]. This study also found different innovation strategy preferences among different types of customers, emphasizing that health and taste are essential for retaining active customers and switching silent customers. In addition, logistic regression analysis shows that there are young consumers who are sensitive to the improvement or innovation of low-fat snacks, suggesting that companies should target these preferences to enhance product attractiveness, promote sales, and increase market share.
(2) Consumer perspective
According to the survey, 93.07 % of respondents were willing to buy low-fat snacks with novel packaging, 94.06 % were in favor of innovative marketing ideas, and 88.12 % accepted new concepts. This indicates that young consumers have a strong willingness to purchase innovative low-fat snacks. In addition, in the digital age, young consumers value branded products with cultural significance and attractiveness, emphasizing the importance of influential first impressions. Consistency in the packaging of low-fat snacks currently discourages purchase intention, suggesting that brands should invest in creative packaging design to capture consumer attention and stimulate desire to buy. Finally, all customer types expressed high expectations for the taste and health of low-fat snacks. Given the low profitability and market share of existing brands, coupled with consumer resistance to the health and taste of existing products, it is clear that enhancing these attributes is essential to influence young consumers ' willingness to buy.

6.2 Proposal

6.2.1 Enterprise

1) Technological innovation is the key to maintain the competitiveness of enterprises[15]. Companies should invest in research and development to discover new low-fat ingredients and bioengineered fat substitutes[16], such as apple fiber, to increase health value and control costs, while developing snacks that help fat burn and improve sleep.
2) Taste is very important for consumers ' choice. Enterprises should focus on product development, create a diversified flavor experience by adjusting the formula, use natural flavors and low-calorie sweeteners, and introduce seasonally restricted flavors to stimulate consumer interest.
3) Innovative packaging design is essential to attract consumers ' attention. Enterprises should use environmentally friendly materials and creative logos to convey brand value through packaging stories. In addition, the design should be social media friendly to increase brand awareness.。
4) Strong brand image is an important asset. Enterprises should clarify brand positioning, use public relations and social responsibility initiatives to carry out effective marketing and create a positive image. For brands with negative perception, transparency in dealing with problems helps to rebuild trust.。
5) Collaborative IP and interactive marketing can attract young consumers. Enterprises should cooperate with popular movies and games, provide limited edition products, and use social media to carry out online activities to promote consumer participation.

6.2.2 Government

1) The government should strengthen health education and promote reasonable consumption, especially in students and areas with high incidence of disease. Initiatives like advertising and workshops can raise awareness of low-fat and low-calorie choices, as well as the importance of reading food labels.
2) The government should give incentives such as subsidies and tax breaks to health care products manufacturers, and cultivate a supportive market environment that encourages innovation and fair competition through intellectual property protection and legal construction.
3) Governments should regulate the use of fat substitutes to ensure healthy industrial development and implement policies based on successful international practices to address high fat content in snacks.
4) The government should strengthen market supervision and crack down on false advertising in the field of low-fat snacks. This includes enforcing food safety laws, monitoring advertising claims, and establishing consumer reporting and complaint mechanisms to protect consumer rights and maintain market integrity.

COMPETING INTERESTS

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REFERENCES

[1] Thienhirun Chung. Consumer Attitudes and Preferences toward Cross-Cultural Ready-To-Eat (RTE) Food. Journal of Food Products Marketing, 2018, 24(1): 56-79.
[2] Feng Taoling, Liu Yanru. Analysis of the opportunities and challenges faced by low-heat and low-fat snacks. Food Safety Guide, 2020(21): 31. DOI: 10.16043 / j.cnki.cfs.2020.21.024.
[3] Feng Taoling. Problems and suggestions for the development of low-heat and low-fat snacks. Food Safety Guide, 2020(06): 83. DOI: 10.16043/j.cnki.cfs.2020.06.065.
[4] Yu Chuanhua, Rosa, Li Mei, et al. The severity of stroke burden in China from a global perspective. Public health and preventive medicine, 2016, 27(01): 1-5.
[5] Qi Yaning. Research on the Sustainability Evaluation of Earnings in the New Energy Vehicle Industry Based on Factor Analysis. Modern Industrial Economics and Informatization, 2024, 14(06): 58-60. DOI: 10.16525/j.cnki.11362/n.2024.06.017.
[6] Teresia M, Tya A, Kilee K. Gender and Racial/Ethnic Disparities in the Perception of Weight Status, Health Status and Diet Quality Among Adolescents in the USA (P04-114-19). Current developments in nutrition, 2019, 3(S1).

[7] Liao Siyu Research on the current situation, influencing factors and Countermeasures of financial management of contemporary college students. China business theory, 2022(03): 82-84. DOI: 10.19699/j.cnki.issn2096-0298.2022.03.082.
[8] Zhu S, Lv X, Yu L. Location Privacy Protection Method based on Variable-Order Markov Prediction Model//The International Society for Applied Computing.Proceedings of 2021 4th International Conference on Computer Science and Software Engineering (CSSE 2021). College of Computer Science and Technology, Hohai University, 2021: 6. DOI: 10.26914/c.cnkihy.2021.052072.
[9] Andrea P D, Alessandra T, Roberta N, et al. Prenatal planning of placenta previa: diagnostic accuracy of a novel MRI-based prediction model for placenta accreta spectrum (PAS) and clinical outcome. Abdominal radiology (New York), 2019, 44(5): 1873-1882.
[10] Wang Yanguang, Zhu Hongbin, Xu Weichao. Review of ROC curve and its analysis methods. Journal of Guangdong University of Technology, 2021, 38(01): 46-53.
[11] Zhao Xinran. On the new consumption concept and consumption policy in the post epidemic period. China market, 2022(03): 129-130. DOI: 10.13939/j.cnki.zgsc.2022.03.129.
[12] Wu Xiaoxue. Research on user segmentation of Internet financial platform based on RFM improved model. Beijing Jiaotong University, 2017.
[13] Luo Yi. Research on passenger traffic prediction model based on grey theory and generalized regression neural network. Southwest Jiaotong University, 2007.
[14] Wang Qiang. To explore the trend of China 's catering development after the new coronavirus epidemic. The Age of Wealth, 2020(02): 238.
[15] Innovation of Key Technologies: to Build the Core Competitiveness of Enterprises. China Oil & Gas, 2020, 27(05): 27.
[16] Brennan S C. Regenerative food innovation delivering foods for the future: a viewpoint on how science and technology can aid food sustainability and nutritional well‐being in the food industry. International Journal of Food Science & Technology, 2023, 59(1): 1-5.