Investigation on Brand Satisfaction of Huoshan Huangya Based on Principal Component Analysis — A Case Study of Anhui Province

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Abstract: This paper attempts to use SPSS software to carry out empirical research on the satisfaction of Huoshan Huangya tea products in Anhui Province. Through questionnaire survey, consumers' evaluation of Huoshan Huangya tea is collected. Reliability analysis is used to prove the reliability of the article and the significance of the data. Then principal component statistical analysis is used to explore the main factors affecting consumer satisfaction. The advantages and disadvantages in the production and sales process of Huoshan Huangya are discussed. It provides reference and suggestions for tea production enterprises and related departments.

Keywords: Huoshan Huangya, satisfaction degree, principal component analysis

1. Introduction

Huoshan Huangya tea is one of the traditional famous teas in China. It has a long history and unique taste. It is produced in Huoshan County, Anhui Province. It is praised for its bright yellow color and rich aroma. With the improvement of people's living standard, consumers have higher and higher requirements for tea quality and taste, and Huoshan Huangya seems to have gradually faded out of the sight of tea drinkers. So our survey emerged, using a questionnaire survey to determine the public satisfaction of Huoshan Huangya, and taking a series of measures to save this situation.

1.1 Conceptual synthesis

(1) Reliability analysis: Reliability analysis is the use of statistical methods to assess the stability and reliability of research instruments. In questionnaires or experimental studies, reliability analysis is used to test the consistency and stability of measurements. Various reliability coefficients, such as Cronbach's Alpha coefficient and Guttman Split-Half coefficient, are calculated to assess the reliability and stability of research instruments.

(2) Satisfaction of Huoshan Huangya products: The satisfaction degree of Huoshan Huangya tea products refers to two parts: consumers 'perception and experience of Huoshan Huangya tea essence and their satisfaction degree of sales marketing. By understanding consumers 'satisfaction degree of Huoshan Huangya tea products, we can evaluate the market performance of products and the satisfaction degree of consumers' needs, and provide important decision-making basis for tea manufacturers.

(3) Principal Component Analysis (PCA): Principal Component Analysis (PCA) is a common multivariate data analysis method used to reduce the dimensionality of data and extract the main features of the data. Its goal is to map the original data to a new coordinate system through linear transformation, so that the data in the new coordinate system has the largest variance. These new coordinates are called principal components and are sorted according to their contribution to the variance of the data.

1.2 Sample and data collection

The questionnaire survey was conducted in 16 cities in Anhui Province. The survey objects were ordinary residents in Anhui Province. In order to avoid chance, the questionnaire was distributed randomly. 620 questionnaires were distributed in this survey, 500 were recovered, the recovery rate was 80.6%, and the effective rate was 100%.

Table 1. Distribution table of demographic characteristics of questionnaire survey

Gender	Male			Female		
Frequency (%)	51.8			48.2		
age	under the age of 18		19-29 year-old	30-50 year-old		over the age of 50
Frequency (%)	7.6		16	30.8		45.6
Vocational	Students	Employees of companies or administrative institutions	Merchants, self-employed	Freelance	Retirees	Other
Frequency (%)	9.4	15.2	15.6	23.8	26	10.0
Degree	High school and below		College	Bachelor's degree		Graduate students and above
Frequency (%)	23.2		23.4	41.4		12
Average monthly income	Below 2000 yuan		2000-5000 yuan	5000-8000 yuan		More than 8000 yuan
Frequency (%)	23.2		23.4	41.4		12
Married or not	Yes			No		
Frequency (%)	82.8			17.8		

Male accounted for 51.8% and female for 48.2% of the total sample, with males slightly outnumbering females (49.8%), aged over 50 45.6% of them had bachelor degree or above (53.4%), their monthly income was 5000 - 8000 yuan (41.4%), and they were married (82.8%). (Table 1)

2. Data analysis

2.1 Questionnaire design

The questionnaire was designed with multi-dimensional consideration and five-level scale, and open-ended questions were set up. The main part of the questionnaire was composed of 8 related variables affecting the satisfaction of Huoshan Huangya tea, which were divided into two parts: the perception experience of Huoshan Huangya tea essence (taste, process quality, tea soup color, tea shape), and the satisfaction of its sales marketing (purchase route, tea price, product packaging, shelf life).

2.2 Reliability analysis

Both test-retest reliability and duplicate reliability need to be tested many times for the same group of subjects. Because the survey of Huoshan Huangya's satisfaction in Anhui Province has many limitations, such as it is difficult to prepare duplicates, the mobility of subjects is large, and it is difficult to repeat the test. Therefore, this paper makes full use of the data obtained from one test to carry out reliability test, saving time and manpower, reflecting the internal consistency of the test, that is, the internal consistency reliability coefficient (Table 2).

Table 2. Internal consistency α coefficient test

	Scale Average with Term Deleted	Scale variance after deletion	Corrected Term and Total Correlation	Squared multiple correlation	Cloned Bach Alpha after deletion
Taste	23.87	19.503	0.136	0.204	0.677
Process quality	24.09	16.266	0.483	0.275	0.588
Tea soup color	23.97	17.049	0.437	0.272	0.603
Tea appearance	24.08	18.294	0.290	0.403	0.640
Purchase route	24.36	16.286	0.500	0.482	0.584
Tea prices	24.25	18.460	0.253	0.212	0.649
Product packaging	24.19	16.682	0.479	0.564	0.592
Shelf life	23.78	18.733	0.228	0.186	0.655

Table 3. Reliability statistics

Cronbach's alpha	Standard term based Cronbach's alpha	Number of items
0.756	0.755	8

As can be seen from Table 3, $R_x > 0.7$, the above indexes all showed that the questionnaire fit degree was high.

2.3 Validity analysis

Exploratory factor analysis (KMO) is a series of methods used to discover the potential structure of a group of variables. By finding a smaller set of potential structures or hidden structures to explain the relationship between observed explicit variables, it can divide complex data into multiple dimensions, and it can also explain the structure validity of questionnaires.

Bartlett sphericity test is a statistical test method based on chi-square distribution, which is used to test whether the variances among multiple variables are equal. The null hypothesis of this test is that the variances among variables are equal. If the calculated associated probability value is less than the significance level, then the null hypothesis should be rejected. It is considered that the correlation coefficient cannot be a unit matrix, that is, there is correlation between the original variables, and it is suitable for factor analysis. On the contrary, it is not suitable for factor analysis.(Table 4)

Table 4. KMO and Bartlett test

KMO sampling appropriateness measure		0.667
Bartlett's sphericity test	Approximate chi-square	855.566
	Degrees of freedom	28
	Significant	0.000

The KMO test result was 0.667 and Bartlett sphericity test significance was less than 0.05. The statistical significance of the data was high, and factor analysis could be used.

2.4 Principal component analysis

The satisfaction degree questions set in this questionnaire all reflect the influence degree of customers on Huoshan Huangya satisfaction degree, but due to the too many dimensions of the questions, we use principal component analysis to reduce the dimensions of the questions in the questionnaire. After the initial arrangement of the original collected data, we use IBM-SPSS statistical software and the basic principle of principal component factor analysis to analyze the statistical correlation of 8 kinds of evaluation variables. Three principal component factors affecting satisfaction degree were found out by eigenvalue and cumulative contribution rate, and quantitative evaluation was carried out on these factors.

Based on the above 8 quantitative evaluation indexes, SPSS factor analysis and principal component analysis were used to obtain the contribution rate, rotated component matrix and eigenvector matrix of each principal component by setting eigenvalues greater than 1. From the table, three principal components were selected for principal component analysis, and their contribution rates were 31.121%, 19.055%, 13.865%, The cumulative contribution rate was 64.042%, i.e. the 3 principal components covered more than 64.042% of the data information of 8 impact evaluation indexes.

Table 5. Total variance interpretation

Ingredients	Initial eigenvalue			Extract load square sum		
	Total	Percentage variance (%)	Cumulative (%)	Total	Percentage variance (%)	Cumulative (%)
1	2.49	31.121	31.121	2.49	31.121	31.121
2	1.524	19.055	50.176	1.524	19.055	50.176
3	1.109	13.865	64.042	1.109	13.865	64.042
4	0.818	10.227	74.269	-	-	-
5	0.726	9.071	83.34	-	-	-
6	0.601	7.51	90.85	-	-	-
7	0.491	6.132	96.982	-	-	-
8	0.241	3.018	100	-	-	-

Note: "-" indicates no data.

The eigenvector matrix can reflect the load of each index on each principal component. It can be seen from Table 10 that the first principal component is mainly determined by the purchase route; the second principal component mainly represents the influence of tea appearance; and the third principal component represents the taste factor (Table 6).

Table 6. Eigenvector matrix

Project	Ingredients		
	1	2	3
X_1	0.227	0.518	0.681
X_2	0.712	0.407	-0.387
X_3	0.678	-0.175	0.049
X_4	0.466	-0.511	-0.262
X_5	0.378	-0.514	0.464
X_6	0.740	0.006	-0.271
X_7	0.448	0.678	0.030
X_8	0.602	-0.274	0.368

Set taste, product packaging, process quality, tea price, shelf life, purchase route, tea shape, tea soup color in the proportion of 16 variables standardized data in turn $X_1 \sim X_8$, then the principal component expression is obtained according to the table:

$$y_1 = 0.027x_1 + 0.712x_2 + 0.687x_3 + 0.466x_4 + 0.378x_5 + 0.740x_6 + 0.488x_7 + 0.602x_8 \tag{1}$$

$$y_2 = 0.518x_1 + 0.407x_2 - 0.175x_3 - 0.511x_4 - 0.514x_5 + 0.006x_6 + 0.678x_7 - 0.274x_8 \tag{2}$$

$$y_3 = 0.681x_1 - 0.387x_2 + 0.049x_3 - 0.262x_4 + 0.464x_5 - 0.271x_6 + 0.300x_7 + 0.368x_8 \tag{3}$$

After calculating the above three principal components by using the quantized variable values, the variance contribution rate of each principal component is used as the weight to construct the comprehensive evaluation index of influencing factors of customer satisfaction to Huangshan Huangya:

$$F = 0.31121x_1 + 0.19055x_2 + 0.13856x_3 \tag{4}$$

According to the above statistical analysis, it is also proved that Huoshan Huangya needs to increase publicity efforts, open up sales, maintain the original taste, develop innovation, broaden the tea peripheral product chain, improve the tea processing technology, strengthen the supervision of each step of the process, etc. This can make the audience more satisfied and accepted.

3. Results analysis and recommendations

Some analysis and suggestions are put forward according to the data obtained from the survey:

3.1 Cultivate and strengthen leading enterprises and enhance the corporate image of "Huoshan Huangya" brand

Strengthen the cooperation between government and enterprises, rely on the dominant backbone enterprises. On the one hand, Huoshan County government needs to pay close attention to this characteristic industry, change the development concept, unite all villages and towns to jointly create the "Huoshan Huangya" tea brand, expand the market scale of enterprises. On the other hand, rely on leading enterprises to realize the production transformation of Huoshan Huangya into efficient management. Cultivate and strengthen leading enterprises, improve the market competitiveness and production innovation ability of enterprises, in order to better play the main guiding role, Enhance the brand image of Huoshan Huangya.

3.2 Create ecological green products and consolidate the brand image of "Huoshan Huangya"

Huoshan Huangya leading enterprises should strengthen the organic, green and ecological cultivation of tea, actively build organic tea gardens, reduce the use of chemical fertilizers and pesticides, improve soil organic matter, improve tea quality, give full play to local climate and natural conditions endowment, accelerate the construction of standardized tea bases, improve tea planting quality and scale effect, and launch ecological, green, Organic tea products. Meet the current demand for high-quality tea consumption, tamp Huoshan tea brand product image.

3.3 Expand the peripheral product chain, improve the brand value and market competitiveness of Huoshan Huangya.

For example, they can develop tea sets, tea foods, tea health products and other peripheral products related to tea, to increase the added value of products and market competitiveness. At the same time, can also carry out tea culture tourism, tea performances and other activities, enhance consumer awareness and interest in Huoshan Huangya brand, for the long-term development of the brand to lay a solid foundation.

References

[1] WEN Fei, GUO Wanqi, ZHAI Yaling. Study on brand image cognition promotion strategy of "Ya Xiangxi Golden Tea"--data analysis based on questionnaire survey [J]. *Modern Agricultural Science and Technology*, 2023 (02):204-209.

[2] Kang hyunuk. Investigation and analysis of consumption characteristics of Chinese tea in Korea [D]. Yunnan Agricultural University, 2017.

[3] Wang Hui, Gong Shuying, Li Gancheng. Investigation and Thinking on Tea Shops and Teahouses in Changxing County [J]. *Tea*, 2011, 37 (02):102-105.