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Evaluation and survey of nutrition and sensory quality in domestic and foreign milk sold in China

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Abstract

Consumer choice of milk commonly lacks a scientific basis, and consumers are often unable to obtain the most suitable milk for themselves. As far as know, data profile has not been used to investigate and compare the quality of domestic and foreign milk in Chinese market. Therefore in the current study, we compared the quality of 112 domestic brands and 48 foreign brands using independent samples t-test, correlation analysis, multivariate linear regression analysis, principal component analysis and sensory analysis. In addition, a questionnaire survey was conducted to understand the factors affecting consumers' purchase intention. The results show the contents of protein, calcium and fat in domestic milk were lower than those in foreign milk, whereas domestic milk achieved a higher 50 percentile score in the sensory analysis, but the principal component analysis showed no obvious difference in sensory quality between domestic and foreign milk. The correlation analysis results revealed that the price of domestic milk was strongly positively correlated with protein and fat. Multivariate linear regression analysis showed that protein has significant and positive impact on the price. The questionnaire survey revealed that protein, calcium and fat were the most important nutrients consumers sought to obtain through drinking milk.

Keywords: milk quality; data profile; multivariate statistics; sensory analysis.

Practical Application: Establish a scientific basis for milk consumption choices.

1 Introduction

As one of the most important daily consumer goods in the world, many previous studies have examined the quality and market dynamics of milk. A range of factors affect the quality of milk, including the variety of cow (Orang, 2008), type of feed(Santiago et al., 2019) and rearing environment (Ranjitkar et al., 2020). Detection of residues of feed additives and toxic substances in milk, such as veterinary drugs (Han et al., 2013; Valenca et al., 2020), bacteria (Rabelo et al., 2021), aflatoxin M1 (Zheng et al., 2013) and heavy metals (Boudebbouz et al., 2021),is important for controlling the quality of milk. Increased understanding of milk consumption would be useful for informing the production and sale of milk, as well as consumers' purchasing behavior. Two main types of market research have been conducted: first, research on trends in milk consumption, including generational effects on milk consumption (Stewart et al., 2012), double hurdle analysis of demand for powered milk (Wu et al., 2014), trends for using packaged milk (Kamran & Rizvi, 2013), and trends of milk consumption among Chinese children (Liu et al., 2011); and second, surveys of consumers' preferences and attitudes toward milk, such as confidence in food safety of milk powder(Wang et al., 2019) and health perceptions of three types of milk (Bus & Worsley, 2003).

China's per capita milk consumption is lower than the world average. However, with rapid economic development, China's milk demand is increasing rapidly. Chinese researchers have estimated that China's milk consumption in 2050 will be 3.2 times of that in 2010 (Bai et al., 2018). Foreign researchers have speculated that China's milk market will become one of the most important milk markets in the world (DuBois, 2019; Wiley, 2007). Because of the substantial development potential of China's milk market, China's domestic milk industry has developed quickly, and a number of foreign milk brands have entered China to seize the market.

The choice between domestic and foreign milk is controversial among Chinese consumers. The choices of some consumers in China were affected by the melamine scandal several years ago, causing doubts about the quality of domestic milk (Pei et al., 2011) and leading to a preference for foreign milk. Some consumers think that improvements of the law and increased attention to food safety by government (Chen et al., 2021a; Hong et al., 2021; Tian et al., 2021) have improved the quality of domestic milk, the price of which is comparatively low, leading them to choose domestic milk. In addition, some consumers think that the taste of domestic milk is more agreeable to the taste preferences of Chinese people, whereas some think that foreign milk has a better nutritional content. However, these arguments are the personal views of consumers, or impressions formed under the influence of parents, friends, or the media, lacking a scientific basis.

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There are several ways to investigate and evaluate the quality of milk. Such as Mid and near-infrared spectroscopy (Grelet et al., 2021; Szwarcman et al., 2021; Zhu et al., 2019), mass spectroscopy (Chen et al., 2021b; Tarhan & Kaya, 2021), nuclear magnetic resonance (Soyler et al., 2021; Zhu et al., 2020) and milk analyzer (Santos et al., 2021). Researchers usually use these techniques to optimize milk production (Arco-Pérez et al., 2017; Zhu et al., 2020) and quality inspection for a small number of products (Chen et al., 2021b; Soyler et al., 2021). Because different nutrients have different chemical and physical properties, it is usually impossible to obtain protein, fat, calcium and other nutrients at the same time if only one technical means is used (Li et al., 2021). Through the nutritional profile, we can quickly and accurately obtain the complete quantitative information of nutritional components of products. Based on the analysis of the nutritional database, we can do the research related to the marketing and consumer behaviors (Rojas et al., 2020; Taillie et al., 2018). This method is especially suitable for comparing the quality of products of different brands in a wide range (Drewnowski & Rehm, 2009)and understanding the overall situation of a certain type of products on the market (Dunford et al., 2014; Wolfson et al., 2020). As far as know, data profile has not been used to investigate and compare the quality of domestic and foreign milk in Chinese market. At the same time, Chinese consumers are lack of scientific basis in the choosing of domestic and foreign milk. To fill the gap of this field, we collected nutritional information and prices of 162 brands of milk from biggest online supermarkets of China, including 114 from China and 48 from other countries. In the current paper, we used statistical methods to compare differences in nutritional components and taste between domestic and foreign milk. In addition, a questionnaire survey and a sensory analysis of milk preference were conducted. This study aimed to establish the nutrition database of domestic and foreign milk in Chinese market, provide a scientific basis for Chinese consumers regarding the choice of domestic or foreign brands of milk, as well as the milk consumption behavior of Chinese consumers from a quantitative perspective.

2 Survey design

2.1 Data collection

We obtained milk nutrition tables and prices of 162 brands (114 Chinese brands and 48 brands from other countries) from the biggest online supermarkets of China (Tmall.com). To better analyze the nutritional information of fat, skim milk was not included in the current study.

2.2 Questionnaire survey

A total of 500 questionnaires were collected from 500 consumers, 499 of which were qualified, with a pass rate of 99.8%. The sample included 243 men (48.7%) and 256 women (51.3%).

Question 1 (multiple choices): What factors do you consider when buying milk?

A. Nutrition B. Taste C. Price

Question 2 (multiple choices): What nutrients do you drink milk for?

A. Protein B. Healthy fat C. Carbohydrate D. Sodium E. Calcium F. Vitamins

Question 3 (single choice): Which do you choose when you buy milk: domestic or foreign brands?

A: Chinese brands B: Foreign brands

2.3 Sensory analysis

Nine Chinese brands and eight other national brands of milk were purchased through a traditional supermarket. The samples were placed at room temperature for a period of time before being tasted to ensure that the product temperature was approximately 20 °C. Milk was poured into colorless, tasteless, disposable paper cups with no distinctive markings, and given to the tasters. After drinking each brand of milk, the tasters cleaned their mouths with warm boiled water before tasting another brand of milk.

A total of 10 trained panelists used touch, vision, smell and taste to perform relevant evaluations. The 10 panelists were in good health and had no lactose intolerance. Before the evaluation, judges did not use cosmetics or perfume that could affect the evaluation of odors, and did not eat 1 hour before tasting.

The total score was 100 points, including color (10 points), viscosity (10 points), texture (10 points), personal preference (10 points), odor (30 points) and taste (30 points).

2.4 Statistical analysis

Statistical analyses were conducted using SPSS 25.0 (SPSS Inc., Chicago, IL, USA). Data were analyzed using independent-samples t-tests with Chinese brands vs other national brands. Pearson's correlation analysis was used to analyze the correlations between nutrient compositions and price. Multivariate linear regression analysis was used to analyze how nutritional components influence the milk price. Significance was determined at $P<0.05$.

3 Results and discussion

3.1 Independent samples t-test

Energy: It can be seen from Table 1 that the average energy content of domestic milk was higher than that of foreign milk, and there was no difference between the two kinds of milk ($P > 0.05$).

Protein: The protein content of domestic milk was lower than that of foreign milk, and there was a significant difference between the two kinds of milk ($P < 0.05$). The protein standard of milk in China is more than 2.8 g, whereas most western countries require a protein standard of more than 3.2 g. Based on the average values, the results revealed that the protein level of Chinese milk met the requirements of western countries. However, the standard deviation (SD) indicated that some Chinese brands only met the protein standard of China.

Fat: The fat content of domestic milk was lower than that of foreign milk, but the difference was not significant ($P > 0.05$). Milk fat is considered a healthy fat, which is an irreplaceable

Table 1. Independent samples t-tests of domestic and foreign milk.

Items	Domestic (N=114)	Foreign (N=48)	Significance
Energy (KJ/100 mL)	270.391 ± 34.1314	268.491 ± 30.6004	0.739
Protein (g/100 mL)	3.223 ± 0.3162	3.418 ± 0.2621	0.000
Fat (g/100 mL)	3.411 ± 0.9342	3.388 ± 0.7747	0.880
Carbohydrates (g/100 mL)	5.253 ± 0.9831	4.959 ± 0.5742	0.019
Sodium (g/100 mL)	0.05845 ± 0.009370	0.04511 ± 0.006910	0.000
Calcium (g/100 mL)	0.113458 ± 0.0155558	0.120582 ± 0.0109005	0.001
Price (rmb/100 mL)	2.1492 ± 0.98208	2.9399 ± 2.39236	0.031

Mean ± SD. N is the number of samples.

nutrient (German et al., 2009; Jacques et al., 1999). Milk fat is the source of the flavor of milk (Lubary et al., 2011), and is the raw material for butter, cream, ghee and cheese (Jaster et al., 2018; McCarthy, 2006; Pena-Serna & Restrepo-Betancur, 2020). Therefore, fat is a key factor in determining the quality of milk.

Carbohydrate: The carbohydrate content of domestic milk was higher than that of foreign milk. The carbohydrate of milk mainly comes from lactose, and many Asian people are lactose intolerant (Davis & Bolin, 1967). Our survey results revealed no lactose-free milk among the 164 brands. Thus, the market of lactose intolerant people in China is waiting to be exploited.

Sodium: The average content of sodium in domestic milk was higher than that in foreign milk. This may be related to the excessive sodium in the Chinese diet, with sodium excreted by humans potentially entering the feed and growth environment of dairy cows. The sodium intake of people in China is twice that recommended by the World Health Organization (Tan et al., 2019). Thus, milk with low sodium content may be more suitable for Chinese people.

Calcium: The average calcium content of domestic milk was significantly lower than that of foreign milk. The calcium content of milk is an important index for evaluating the quality of milk. Chinese people have been reported to lack calcium in their diet (Lau et al., 2001), and milk is a good source of calcium.

Price: The average price of domestic milk is lower than that of foreign milk. The high price of foreign milk may be related to tariffs placed on imported milk. It should be noted that the SD and mean of foreign milk were similar, indicating that the price distribution of foreign milk was discrete, with some brands targeting the high-end market.

Overall, important quality indexes, such as protein, fat and calcium of Chinese milk were lower than those of foreign milk. The SD values of nutritional components of domestic milk were higher than those of foreign milk. We speculate that the reason for this may be that some milk manufacturers produce milk following Chinese standards, while others produce milk following Western standards, leading to substantial differences in the quality of Chinese milk.

3.2 Price analysis

The correlations between price and brands, as well as nutritional components, are shown in Table 2. In SPSS, we used 0 for domestic milk and 1 for foreign milk. It can be seen from the table that the price was positively correlated with brands (Pearson's correlation coefficient is 0.230), indicating that larger values were associated with higher prices. This result indicated that the price of foreign milk is higher, consistent with the results of the independent samples t-test analysis above.

The price of domestic milk was directly proportional to protein and fat content, and inversely proportional to carbohydrate content. The Pearson's correlation coefficient for the relationship between price and protein was 0.513, indicating a strong correlation between price and protein: higher protein content was associated with higher price. The fat content was also a positive correlation with the price, and the Pearson's correlation was 0.340 which consistent with the questionnaire investigation above (Protein, calcium and fat are top 3 nutrients which consumers drink milk for). It is worth noting that there is almost no correlation between the calcium content and the price, which may indicate that the price of high calcium milk is not higher than that of ordinary milk, or the calcium content of high price milk is not higher than that of low price milk. High sugar diet can lead to diabetes, obesity, cardiovascular diseases and other health problems (Hung et al., 2003). More and more people feel a sense of rejection towards carbohydrate, so the higher the content of carbohydrate, the lower the price is not surprising. But in fact, compared with some common drinks such as cola, yogurt and fruit juice, milk has lower carbohydrate content.

Protein, fat and carbohydrate (P<0.01, Seen in Table 2) were used as variables in the multivariate linear regression analysis. As shown in Table 3, the linear regression model had acceptable fit (R^2 = 0.269), which means that the variables explain 26.9% of the price. The regression equation was significant (P< 0.001), indicating that at least one variable can significantly affect the price. Multiple collinearity did not exist between variables (all VIF<5). The fat and carbohydrate did not significantly affect the price (P> 0.05). Protein (β=0.014) had significant and positive impacts on the price, and the final regression Equation 1 was obtained as:

$$Price\ (rmb/mL) = -0.024 + 0.014 \times Protein\ (g/\ 100\ mL) \quad (1)$$

From the regression equation, focusing on improving the protein content may lead to a higher price of domestic milk in China.

It should be noted that the correlation analysis revealed no significant correlation between the price of foreign milk and the nutritional composition of milk. We speculate that this finding may have been caused by costs related to tariffs and international

Table 2. Pearson's correlation coefficients among all variables.

		Origin	Protein	Fat	Carbohydrates	Sodium	Calcium
Price	Pearson correlation	0.230**	0.334**	0.203**	-0.253**	-0.145	0.024
N=162	Significance	0.003	0.000	0.009	0.001	0.065	0.758
Price of Domestic milk	Pearson correlation		0.513**	0.340**	-0.319**	0.113	-0.084
N=114	Significance		0.000	0.000	0.001	0.233	0.376
Price of Foreign milk	Pearson correlation		0.113	0.128	-0.225	-0.196	0.037
N=48	Significance		0.445	0.387	0.124	0.181	0.805

**P < 0.01, the correlation is significant. N is the number of samples.

Table 3. Multivariate linear regression analysis results for domestic milk.

Model	Unstandardized Beta	Coefficients Std. Error	Standardized Beta	t	Significance	VIF
Constant	-.024	.013		-1.786	.077	
Protein (g/100 mL)	.014	.003	.449	4.094	.000	1.807
Fat(g/100 mL)	.001	.001	.076	.770	.443	1.459
Carbohydrates (g/100 mL)	.000	.001	-.041	-.419	.676	1.461
			R^2=0.269			
			P<0.001			
			Dependent: Price (rmb/mL)			

t: results of t test for regression coefficients; VIF: variance inflation factor; R2: coefficient of determination.

freight in foreign milk. However, we did not conduct statistical analyses of these two costs.

3.3 Sensory analysis

The detailed sensory evaluation standard of milk is in Table 4. The sensory analysis scores did not accord with normal distribution, so the non- parametric analysis was used. The 50 percentile of domestic milk was higher than those of foreign milk in terms of color, texture, aroma, taste and total score (Table 5). Although the score Although the scores of domestic milk in many aspects were higher than those of foreign milk, the Mann-Whitney U non-parametric test showed there were only significant difference between in preference and total score (P<0.05, Table 5), which shows that there was no obvious difference in the sensory quality of domestic and foreign milk, but since the panelists are all Chinese, there were personal preferences for Chinese milk. Principal Component Analysis was also conducted to evaluate the difference of the sensory quality parameters between domestic and foreign milk. The use of this technique allows identifying the main quality parameters that contribute to most of the observed variation in the observed results. As can be seen in Figure 1, most indicators are well represented in PC 1 and PC 2. As PC 1 explained 57.5% of the total variance and PC 2 explained 14.6%, two dimensions are able to explain 72.1% of the sensory quality parameters for domestic and foreign milk. From the PCA biplot, sensory qualities of domestic and foreign milk are distributed in the similar area, showing that there is no obvious difference which agreed with the result of the Mann-Whitney U non-parametric test. The preference for

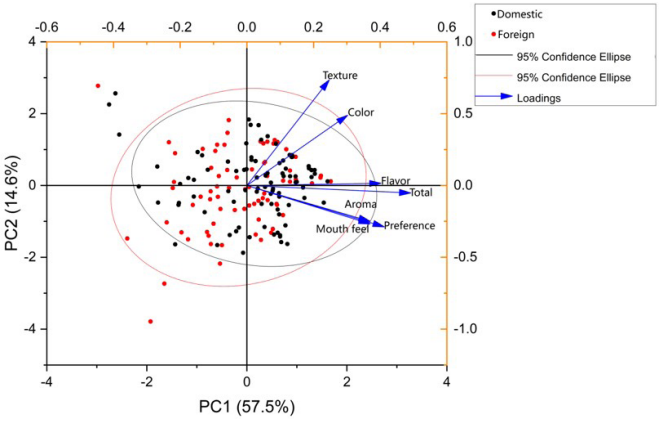

Figure 1. Principal component analysis (PCA) biplot of domestic and foreign milk.

milk may be determined by genes, family, culture, geographical factors and emotions, resulting in tasters ' preference for Chinese milk sources. Another explain for the preference is Chinese consumers are used to the taste of Chinese milk and do not adapt to the taste of foreign milk that has entered the Chinese market for a relatively short time. Therefore, foreign milk to win the favor of Chinese consumers, the use of Chinese milk production is a feasible method.

3.4 Questionnaire investigation

The results of question 1 revealed that, when purchasing milk, the most common consideration was nutrition, accounting

Table 4. The sensory evaluation standard of milk.

Item	Score	Feature
Color (10 points)	10	With uniform yellow or milky white color.
	5~9	With a slightly tar yellow color.
	3~7	With a white cyan color.
Texture (10 points)	10	No coagulation and viscous phenomenon, and liquid is homogenization treated alloy.
	8~9	No coagulation and viscous phenomenon, and the liquid is homogeneous or slightly precipitated.
	6~7	No visible foreign impurities or clots, a small amount of floating fat flocks.
	5~6	There is obvious precipitation.
	0~5	There is coagulation phenomenon.
	0~5	Containing extrinsic contaminants.
Aroma (30 points)	30	Pure fragrance of milk without peculiar smell.
	25~29	Frankincense is not prominent, plain, no peculiar smell.
	20~25	With excessive cooking taste.
	15~19	Containing atypical milk flavor, strong fragrance, or foreign fragrance.
	10~14	Containing slightly stale taste, milk taste impure, or milk powder taste.
	0~9	Milk contains an unpleasant smell.
Flavor (30 points)	25~30	It has the unique rich flavor of milk and the sweet taste of lactose. The overall taste is rich and harmonious, without peculiar smell and atypical milk flavor.
	20~24	The overall taste is slightly lighter, no obvious bad taste.
	15~19	Milk is light, or salty, and prominent sour.
	0~14	Milk drinks very light. There are other uncomfortable bitter, sour and other bad tastes.
Mouth fell (10 points)	8~10	With a pleasant and comfortable taste, the tip of the tongue feels the smoothness and weight of the milk.
	6~7	With a pleasant and comfortable taste, the tip of the tongue feels the smoothness and weight of the milk.
	4~5	Slightly tasted, slightly smooth.
	0~2	Taste is as light as water, and no obvious texture of milk.
Preference (10 points)	0~10	Overall evaluation score from 0-10 points based on personal preference.
Item	Score	Feature
Color (10 points)	10	With uniform yellow or milky white color.
	5~9	With a slightly tar yellow color.
	3~7	With a white cyan color.
Texture (10 points)	10	No coagulation and viscous phenomenon, and liquid is homogenization treated alloy.
	8~9	No coagulation and viscous phenomenon, and the liquid is homogeneous or slightly precipitated.
	6~7	No visible foreign impurities or clots, a small amount of floating fat flocks.
	5~6	There is obvious precipitation.
	0~5	There is coagulation phenomenon.
	0~5	Containing extrinsic contaminants.
Aroma (30 points)	30	Pure fragrance of milk without peculiar smell.
	25~29	Frankincense is not prominent, plain, no peculiar smell.
	20~25	With excessive cooking taste.
	15~19	Containing atypical milk flavor, strong fragrance, or foreign fragrance.
	10~14	Containing slightly stale taste, milk taste impure, or milk powder taste.
	0~9	Milk contains an unpleasant smell.
Flavor (30 points)	25~30	It has the unique rich flavor of milk and the sweet taste of lactose. The overall taste is rich and harmonious, without peculiar smell and atypical milk flavor.
	20~24	The overall taste is slightly lighter, no obvious bad taste.
	15~19	Milk is light, or salty, and prominent sour.
	0~14	Milk drinks very light. There are other uncomfortable bitter, sour and other bad tastes.
Mouth fell (10 points)	8~10	With a pleasant and comfortable taste, the tip of the tongue feels the smoothness and weight of the milk.
	6~7	With a pleasant and comfortable taste, the tip of the tongue feels the smoothness and weight of the milk.
	4~5	Slightly tasted, slightly smooth.
	0~2	Taste is as light as water, and no obvious texture of milk.
Preference (10 points)	0~10	Overall evaluation score from 0-10 points based on personal preference.

Table 5. Sensory evaluation of domestic and foreign milk.

	Color	Texture	Aroma	Taste	Mouth feel	Preference	Total
Fo1	7(6\10)	10(7\10)	25.5(14.25\28.5)	21(18.75\24)	5.5(3\7)	5(4\7.125)	70(60.25\80.625)
Fo2	8(7\9.25)	9.5(7.75\10)	25(19.75\26.5)	22.5(19.75\25)	5.5(4.75\6.5)	6(5\7.25)	71.5(68.25\81.5)
Fo3	7.5(5.75\8.5)	8.5(7.5\10)	24.5(13\26)	15(15\20.5)	4.5(2.75\5.5)	5(2\5.25)	62(54\72.5)
Fo4	8(8\9.25)	9.85(9\10)	25(24.75\28)	25(24\27)	7(6.5\8)	7(6.75\8)	81.5(78\86.3)
Fo5	8(6.75\8.5)	9(7.5\10)	25(23.75\26)	22.5(15\23)	5(3.75\5.5)	5(3.5\6.25)	72(62.5\79)
Fo6	9(7.75\9.4)	10(7.75\10)	25(24.25\27.75)	25(21.5\27)	7(6.75\8)	7(7\8)	82(77.5\86.5)
Fo7	8(8\9.25)	9(8.75\9.25)	25(20.75\27.25)	23.5(18\26)	7(6.375\8)	7(6\8)	76.5(69.125\84.625)
Fo8	8(7\10)	9(8\10)	26(20.5\28.25)	24.5(22.5\27.25)	7(6.5\8)	7.25(6\8)	81.75(69.75\90.125)
All Fo	8(7\9)	9(8\9)	25(22\27)	23(19.25\23)	7(5\7)	6(5\7.5)	77(68.25\83)
Do1	8(6.75\10)	9.5(8\10)	27(22.75\28)	24(22\25.5)	7(5.5\9)	7.25(4\8.25)	79.75(67.125\91.5)
Do2	8(5.75\10)	8.5(8\10)	24.5(11.5\26)	16(5\21.5)1	5(4\6.25)	5(2\6.25)	63(52.5\76.75)
Do3	8.5(7\10)	9.5(8\10)	26(24.75\27.5)	25(21.5\26)	7(5.75\7.25)	7.5(5.5\8)	82(78.25\85.75)
Do4	8.75(7.75\9.25)	10(8\10)	27(24.5\28)	23.5(21.5\26.25)	6.5(5.75\7.25)	8(6.5\8.25)	82.5(76.75\88.125)
Do5	8.6(8\10)	9.4(8.75\10)	25(24.5\28.25)	22(19.25\26)	6.5(4.75\7)	6(5.75\7)	76(73\85.25)
Do6	8(7\10)	9.25(8.75\10)	25.5(23.5\28)	21(18\26.25)	6(4\7)	6.5(4.5\7)	77.75(67\85.25)
Do7	8.5(8\9.25)	9.4(8.75\10)	27.5(24.25\28.25)	24.5(21.5\25)	6.5(5\8)	7.25(5\8)	82.9(75.25\85)
Do8	9(7.75\9.25)	9.5(8\10)	25(25\27.25)	25(24\26)	7.6(7\8.25)	7.75(6\8.25)	83.1(81.25\86.625)
Do9	9(8\9.7)	10(8.75\10)	26(25\28)	26(25\26.25)	8(6.75\8)	8(6.75\8.55)	85.5(82.75\88.75)
All Do	8.1(8\10)	9.9(8\10)	26(25\28)	24(20.26)	7(5\8)	7(6\8)	82(74\85.25)
P	NS	NS	NS	NS	NS	*	*

NS = Non-significant; *P<0.05; Data is given by 50 percentile (25 percentile \75 percentile).

for 58.7% of responses. The second most common consideration was taste, accounting for 48.5% of responses. The third most common consideration was price, accounting for 20% of responses. The survey results revealed that, with the increase in per capita income in China, price was no longer the first consideration for most Chinese consumers, but was still the main consideration for 20% of respondents. Nutrition and taste are the main factors influencing consumers' decisions when buying milk.

The results of question 2: The majority of respondents (88.6%) consumed milk for protein, followed by calcium (69.3%), healthy fat (27.3%), carbohydrates (20.0%), and sodium (12.8%). Regarding nutrition, Chinese consumers pay most attention to protein, calcium and fat. The statistical analysis revealed that the levels of three nutrients in domestic milk were lower than those in foreign milk. To meet the needs of Chinese consumers, China's government should enhance the standards of milk production, leading Chinese milk manufacturers to produce better quality milk.

The results of question 3: regarding the choice of milk brand, 371 people preferred domestic brands, accounting for 74.3% of the sample. The remaining 128 people chose foreign brands. The sensory analysis results indicated that Chinese consumers choose to buy domestic milk mainly because of a preference for its taste.

4 Conclusion

We established a system to quickly compare and analyze the nutritional composition and taste of different brands of milk through the data collection of nutritional composition tables, in addition to statistical analysis and sensory analysis. Independent samples t-tests revealed that the mean levels of protein, calcium and fat were significantly higher in foreign compared with domestic milk. Correlation analysis and multivariate linear regression analysis revealed that the price of domestic milk was positively affected by protein. Therefore, from both sales and consumer demand perspectives, the Chinese government should set higher milk manufacturing standards; Chinese milk producers should improve the quality of milk, particularly protein content. In terms of taste, according to our analysis, domestic milk performed better than foreign milk. However, it should be noted that our sensory analysis was based on data obtained from only 10 panelists. Because of the small sample size, the results may not be representative of the wider population.

Conflict of interest

The authors declare that they have no competing interests.

Availability of data and material

Some or all data, models, or code that support the findings of this study are available from the corresponding author.

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Author contributions

Honghao Cai and Hui Ni: manuscript writing, correction, project set-up and management. Ju Jiang: date collection and analysis. Miaofang Liu and Jiaying Du: questionnaire survey.

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