Sentiment Mining of Consumer Reviews: Evidence from Guangxi Fresh Fruit Supply on China's JD.com E-commerce Platform

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Abstract: This study identifies the product supply chain management issues based on significant data analysis methods by considering user evaluation data from JD.com e-commerce platform, a central e-commerce platform in China. Fresh fruit contributes to substantial sales in e-commerce platforms due to the particular characteristics of freshness. The quality perception of fresh fruits directly affects consumers' trust and willingness to repurchase. Therefore, studying the perceived value of online shopping for fresh fruit consumers in Guangxi, China, is significant to the operation and marketing of fresh fruit e-commerce. In view of these perspectives, we developed a user portrait model for fresh fruits in the Guangxi province based on three key dimensions: user information, fruit category details, and user evaluation information. Utilizing Rost CM software to analyze the content of user comments, including keyword word frequency analysis, semantic network analysis and consumers' shopping sentiment mining, so as to find out the existing problems, and provide decision-making reference for the improvement of the supply chain system of fresh fruits in Guangxi.

Keywords: Sentiment mining, Consumer reviews, Fresh fruit, Guangxi.

1. Introduction

The 51st Statistical Report on China's Internet Development Status from the 51st China Internet Network Information Center projected that in 2022, there would be 1,067 million Chinese Internet users, accounting for 75.6% Internet penetration rate and 845 million online shopping users, an increase of 3.19 million from December 2021constituting 79.2% of the total netizen population（CINIT,2023)[1]. In 2022, the total value of online purchases in China amounted to 13.79 trillion yuan.（CGN,2023）[2];China has become a dominant force in the internet realm. Online shopping is becoming increasingly popular with the general public and is evolving into a worthwhile daily activity,(Xu,&,Zhang,2020)[3]. The tendency toward green consumption is fairly evident among them. Online fresh food purchasing is becoming increasingly popular, and their consumption share is increasing（Nie,2014)[4].

According to the psychological incentive theory, a person's behavior is prompted by their motivation. (Maslow, 1943[5];Deci, & Ryan,1985[6])The behavior is triggered by

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this motivating factor, which also gives it meaning and purpose.(Williams & Hollis,2000)[7] Numerous studies have provided substantial evidence for the strong correlation between motivation and behavior. It was found that motivation plays a vital role in influencing behavior, and diverse motivations lead to distinct behavioral patterns and outcomes(Locke& Latham, 1990 [8]; Elliot & Dweck, 2005[9]). Therefore, defining intrinsic motivation is the basis for the targeted promotion of users' online comments. (Yao, Ding &Liu,2020)[10]The motivation behind publishing online comments stems from the internal drive of consumers to share their opinions online to achieve a specific goal, and the motivation of users to participate in online comments is derived from the combination of internal and external motivation. (Zhou &Hua,2019)[11]. By analyzing online comments, including emotional attitudes, it's possible to gain deeper insight into customer concerns and uncover product issues, which can help monitor brand reputation and product quality(Zhang,2020)[12]. Several e-commerce behemoths have a lot of user information. In order to achieve accurate marketing and deliver personalized recommendations, companies analyze consumers' basic information, shopping behavior, online reviews, and other factors to determine their preferences and behavioral habits. This data is used to classify users, make popular product recommendations, analyze user preferences,

and design products (Hu , 2019)[13].

Utilizing the data derived from Guangxi's fresh fruit production and the Chinese e-commerce platform JD.com, seven fruit varieties with the highest ratings were selected. Then, we collected online customer reviews and conducted extensive research and text analysis to identify current issues with online fresh fruit shopping in Guangxi province. Through investigation, we have given recommendations for purchasing fresh fruit in Guangxi province based on the current situation.

2.Literature Review

Khristianto (2012)[14]used the regression analysis method to investigate twelve variables influencing customer satisfaction. The findings demonstrated that the target website's service quality had the most significant and long-lasting impact on online customers' satisfaction, followed by the system quality, perceived risk, perceived online customers' attitudes, and word-of-mouth advertising from a study conducted by Guo et al. (2012)[15]. The study identified eight critical factors that determine customer satisfaction when shopping online. These factors include web design, security, information quality, payment options, electronic service quality, product quality, product range, and service delivery. Factor analysis and structural equation modeling were used by Habeeb &Sudhakar (2019)[16].to study the influence of service

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quality and satisfaction on the intentions of online shoppers in India. The findings indicated that the website service quality positively influenced user satisfaction with online shopping He et al. (2018)[17].and others developed a fuzzy comprehensive evaluation method for text mining research. With the aid of this new evaluation technique, both consumers and businesses can create more consumer-friendly products. In 2020, Liu et al. and their colleagues identified key factors from online product reviews: packaging style, dietary data, food quality, delivery risk, product freshness, and origin risk. Subsequently, subject words, online data collection, and regression analysis models were used to create the questionnaire. The findings revealed that package layout, dietary data, and food quality contributed to consumer satisfaction. Contrarily, the risks associated with delivery, product freshness, and origin had a negative effect on satisfaction. (Liu et al. 2020)[18]By examining online reviews, Srinivas, Rajendran (2019)[19]and others investigated the factors affecting students' satisfaction with their schools. By analyzing the effect of online reviews on product purchase intentions, Fernando, Mendoza, and others concluded that more reliable reviews lead to higher purchase intentions.(Jiménez &Mendoza ,2013) [20]

Ma & He (2015)[21] used sampling surveys to conduct an

empirical analysis of the satisfaction of online customers in China's rural e-commerce based on the structural equation model. The network environment's security directly influences customer satisfaction with online shopping.To obtain data from e-commerce platforms for fresh agricultural products, Wang (2022)[22]used questionnaires. She subsequently developed a factor model that considers the overall satisfaction of various online customers and conducted empirical analysis. The findings indicated that the two most important variables influencing consumer satisfaction are the quality of agricultural products and the services provided by e-commerce platforms. An X et al. (2018)[23] used crawlers to collect online feedback for some competing goods from Tmall and Jingdong Platform Case Company, organized the subject terms via an LDA model, and then used sentimental labeling to estimate the percentage of customer satisfaction in every aspect. Cheng & Wang (2019)[24] collected consumer online review text data for six different product groups from fresh e-commerce platforms, including fruits, vegetables, and aquatic items and then built a system of factors affecting consumer satisfaction through data extraction and calculated satisfaction ratings for each factor using a sentimental dictionary. Finally, they corrected the negative review data to obtain the lowest after-sales satisfaction

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of the chosen fresh food platform. Ma and Li (2020) [25]used text mining techniques to conclude that logistics services and product quality are the primary indicators of consumer satisfaction regarding fresh product characteristics such as fruit, vegetables, seafood, and meat on the JD fresh e-commerce interface. Wang and Ni (2020)[26] used text data mining technology and LDA models to simulate and evaluate 58,998 Apple product review data from the JD.COM website from the perspective of consumer preferences. The study indicates that customer satisfaction in online agricultural product purchases is significantly influenced by four price-related factors: quality, purchasing experience, logistics, and delivery. The government's agricultural e-commerce support policy and e-commerce companies are focused on minimizing distribution costs, improving e-commerce services, and boosting standards for goods to optimize the distribution and marketing of agricultural products.

Academic studies on online consumer satisfaction via text mining and online evaluations have produced specific outcomes. The drawback is that rarely do consumers of fresh food appear in academic studies on consumer satisfaction with online shopping. Meanwhile, research approaches mainly rely on questionnaires to obtain data and build consumer satisfaction evaluation index systems using empirical or summative methods. Given the data gathered using this method, it is challenging to accurately and objectively measure the factors that influence consumer satisfaction with online shopping. Further research on consumers' perceptions of online shopping is still being done, and very few studies use text mining techniques to analyze the text of fresh food online reviews. This article represents a significant breakthrough by utilizing online reviews to explore the perceptions of online shopping among fresh fruit consumers in Guangxi province. It investigates the profound issues raised in the text of Guangxi's fresh fruit online reviews to generate ideas that can facilitate the expansion of online sales of fresh fruit within the Guangxi province.

3. Method and Datas

3.1 Network Review Mining Process

Text mining technology has received much attention in recent information analysis. This technological advancement enables enhanced information organization by extracting valuable insights from large volumes of unstructured text data. (Ge,et al,2010)[27]. Based on text mining technology, we use evaluation data from the e-commerce platform JD to collect content for analysis. Initially, the category "Guangxi fruit" is chosen, and the review data is gathered, cleaned, and mined using word frequency and word cloud analysis to extract product characteristics, comprehend consumer preferences for product attributes, and perform ROST sentiment analysis on review content data. By judging the proportions of different emotions, the consumer's emotional tendencies and their extent are investigated (Ji et al.2018)[28], and specific recommendations are made based on the findings regarding the growth of online shopping for fresh fruit consumers in the province of Guangxi.

3.2 Introduction to Rost CM software

The Rost CM used in this article is a large-scale free social computing platform developed and coded by Professor Shenyang of Wuhan University in China to assist in humanities and social science research (Shen Y et al. 2009)[29]. This

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platform is capable of conducting file analyses such as microblogging analysis, chat analysis, full analysis, website analysis, browsing analysis, word frequency statistics, English word frequency statistics, traffic analysis, and cluster analysis. It is characterized by objective, systematic, and quantitative description and analysis research methods (Zhang H,2020[30]).

3.3 Data collection rules

JD is a popular and influential e-commerce platform in the e-commerce sector in China. The main reasons for choosing this platform in the present article are; ① The JD platform boasts substantial consumer recognition, with active consumers on the platform reaching 580.5 million as of March 2023. The increased traffic volume of the JD platform correspondingly increased the number and quality of reviews; ② The JD Mall has high usability and security, good website performance, and a complete range of products conducive to collecting and analyzing reviews of various products.

According to the ranking of Guangxi's fresh fruit production and platform sales volume, JD.COM Mall has collected reviews for seven prominent fruits: citrus, mango, banana, lychee, passion fruit, plum, and guava. A total of 21 top-ranking online stores' customer reviews were collected using crawler software to extract user comment information on July 10, 2023. Each review has been categorized into five distinct fields: member ID, review rating, review content, product attributes, and review type. Table 1 displays the specific collection targets.

Table 1

Guangxi Fruit Review Information Form

Category	Merchants	Comments	Category	Merchants	Comments
Citrus	Jingdong supermarket	500,000 +	Lychee	Specialty Guilin Pavilion	1000+
	Yuxianguo flagship store	500,000 +	Passion fruit	Jingdong supermarket	2 million+
	Tanweijun Fresh Flagship Store	100,000+		Tanweijun Fresh Flagship Store	200,000 +
Mango	Mei Zhen Fresh Flagship Store	200,000 +		Kuhara Nongzhen flagship store	20,000+
	Nature Story JD's flagship store	200,000 +	Plum	Taihui Food Franchise Store	5,000 +
	Rongding Fresh Food Store	100,000+		Issei Issei Franchise Store	1000+
Banana	Tanweijun Fresh Flagship Store	200,000 +		Shazhou Youli flagship store	2 hundred+
	Guo Yingxian's flagship store	50,000+	Guava	Tanweijun Fresh Flagship Store	100,000+
	Chinese specialty: Xixia store	20,000+		MLPN Fruit & Vegetable Store	10,000+
Lychee	Flagship store of Tian Liangji	5,000 +		Fresh Oriental flagship store	1000+
	Vienno Fruit & Vegetable Store	2 000 +			

Source:www.jd.com

[30] Zhang H.(2020).A Study on Tourism Trials of Nianhuawan Tourism Town in Lingshan, Wuxi Under the Background of Global Tourism—Based on the Online Comment Data ROST CM Analysis. 6th International Conference on Humanities and Social Science Research (ICHSSR 2020).

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After eliminating duplicate reviews like "default praise for this review," 17,174 consumer reviews for seven products were sorted chronologically. Subsequently, by excluding incomplete, erroneous, and non-compliant data, 13,203 reviews remained, resulting in a data efficiency of 76.9%. The changes in the number of comments before and after this process are depicted in Table 2.

Table 2

Product review data cleaning change

Wares	Original comments	After cleaning	Data efficiency
Seven kinds of fruit	17174	13203	76.9%

Using Rost CM software, 13,203 online reviews were analyzed with participles, such as high-frequency features, semantic networks, sentiment analysis, statistical analysis tables, synonym matrices, sentiment analysis texts, etc. The aim is to obtain information on consumers' positive and negative sentiment evaluation preferences of fresh fruit in Guangxi, visualizing user images and intuitively understanding users' consumption motives, satisfaction, loyalty, and dissatisfaction experiences.

4.Results and Disscussion

4.1 *Word frequency analysis*

The ROST CM 6 software's word frequency statistics function is used in this study to conduct word frequency statistics (Shen Y et al.2009[31];Lin P, et al.2022[32]). Table 3 displays the sixty words that were chosen for analysis. The majority of these reviews prominently feature characteristic words that recur frequently, such as "received," "tasty," "banana," "taste," "packaging," and "fresh." High-frequency terms that pertain to the quality of the fruit products encompass terms like "taste," "fresh," "size," "bad fruit," "ripeness quality," "high quality," "juicy," "palates," "not fresh," "fruit pulp," and "moldy." Additionally, high-frequency terms associated with the seller's aspect encompass terms like "customer service," "service," "merchant," "attitude," "seller," "store," and "comments." On the other hand, the main high-frequency terms related to product distribution include terms like "delivery," "logistics," "JD," "fast," "two days," "speed," and "express delivery." Terms like "cheap," "practical," "value," and "cost-effective" stand out as the main high-frequency related to the product price. High-frequency words related to the types of fruit primarily include banana, fruits, passion fruit, mango, millet banana, orange, guava, etc. However, high-frequency terms with the theme of product packaging mainly include words like packaging, garbage, and foam boxes. In terms of consumer sentiments and interactions, phrases such as tasty, buy, next time, product, sweet, hard to eat, not good, sweet and sour, sweet, and second time emerge as recurrent expressions.

Table 3

High-frequency words for online text reviews

keyword	Frequency	keyword	Frequency	keyword	Frequency
Received	1881	Merchants	391	Juicy	216
Tasty	1485	Shopping	357	Hard to eat	214
Banana	1285	Attitudes	356	Orange	211
Taste	1169	First time	333	Storehouse	211
Packaging	1107	Next time	324	Affordable	209
Fresh	1080	Quality	322	Ripening	203
Fruits	801	Bad reviews	321	Yellowing	202

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Passion fruit	722	Seller	317	Deserve	200
Mango	682	Garbage	310	Palates	199
Size	634	Not familiar	307	Sour-sweet	176
Delivery	604	Inexpensive	300	Guava	175
Fast	578	Sweet	291	Comments	168
Buy	567	High quality	279	Not fresh	163
Logistics	567	Two days	278	Soundly	139
Customer service	566	Speed	265	Cost-effective	134
JD	534	Greens	246	Fruit pulp	128
Bad fruit	523	Right sizes	242	Second time	126
Millet banana	473	Express delivery	239	Moldy	121
Premature	415	Product	235	Colors	121
Serving	391	Pictures	233	Foam box	115

4.2 Semantic Network Analysis

The semantic network analysis graph reflects the connection between words and words, the online text analysis focused on fruit demand, as shown in Figure 1. The results reveal that consumers have significant feedback on issues related to high-frequency words like packaging, received, and fresh. Consumers have high requirements for the quality of fruit. What they value more is the freshness of the fruit. However, there are problems such as yellowing and molds, which seriously affect consumer consumption. The results of this study through network text analysis suggest that merchants should focus more on the packaging and quality of fruits. The results obtained after analyzing online texts on product circulation reveal that consumers also prioritize factors such as the speed of logistics and the integrity of delivery, which also influence the consumer experience.

Similarly, after analyzing online texts concerning product prices, consumers are more concerned about the cost performance of fruit products. To address this concern, merchants should consider the opinions and needs of their customers and take corresponding measures to improve fruit quality, packaging, and other aspects to address the challenges of fruit demand.

Figure 1: Semantic network

4.3 Sentiment analysis

Sentiment factor analysis is the process of distinguishing emotions from online text (Dai P, et al.2019)[33], which means that the high-frequency emotional words are derived from the obtained online text and divided into three categories: positive emotions, neutral emotions, and negative emotions(Tao Y, et al 2019)[34]. Table 4 point out that 6,332 emotional words elicit positive feelings, accounting for 47.96%, 76 expressive words for neutral emotions, accounting for 0.58%, and 6795 emotional words for negative feelings, accounting for 51.46%.

[33] Dai P,Zhang S, Chen Z, et al.(2019).Perceptions of cultural ec osystem services in urban parks based on social networkdata. S ustainability, 11(19):5386.https://doi.org/10.3390/su11195386

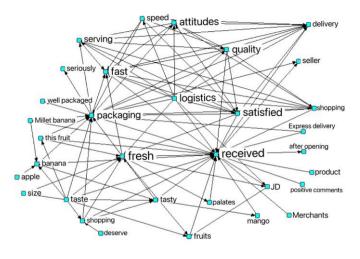[34] Tao Y, Zhang F,Shi C, et al.(2019)Social media data-basedsenti ment analysis of tourists' air quality perceptions.Sustainability,11 (18): 5070. https://doi.org/10.3390/su11185070.

Table 4

Emotional Image Analysis

Overall sentiment statistics	positive mood	6332	47.96%
	neutral mood	76	0.58%
	Negative sentiment	6795	51.46%
Positive sentiment statistics	Generally satisfied	2040	15.45%
	Moderately satisfied	1506	11.41%
	Highly satisfied	2786	21.10%
Negative sentiment statistics	Generally unsatisfied	2520	19.09%
	Moderately unsatisfied	1015	7.69%
	Highly dissatisfied	457	3.46%

4.3.1 Positive sentiment analysis

The words associated with positive emotions were summarized and classified. The main factors influencing the positive sentiment were the relatively good quality of the fruit, the freshness, the seller's good service attitude, fast logistics, strict express packaging, uniform size of the fruit, and high-cost effectiveness.

① The most critical comments are "the fruit products are of good quality" and "the fruit is very fresh." In the collected reviews, most buyers said the fruit is good quality, fresh, sweet, delicious, and very satisfied with its performance.

② "Good seller service attitude" and "Express delivery" also account for a high proportion. Consumers pay more attention to product logistics speed and seller service. In particular, fresh products such as fruit require fast logistics speed to ensure their freshness.

③ "Strict express packaging," "the fruit is relatively uniform in size," and "cost-effective" also account for a significant proportion. The quality and stability of express packaging materials protect the product from damage; the consistency of the appearance and weight of the fruit highlights its beauty. Additionally, the reasonable price and affordability of the fruit cater to the consumers' needs.

4.3.2 Negative sentiment analysis

The words associated with negative emotions were also summarized and classified. The main influencing factors on negative emotions were the virtual phone used by courier companies, poor fruit quality, lots of rotten fruit, unripe fruit, high physical differences, inadequate courier packaging, and average fruit taste.

① The most important fact is that "courier companies use virtual phones." Using virtual numbers presents certain potential issues. Virtual numbers may increase users' distrust of couriers, and users may be unable to directly contact actual couriers, resulting in poor consumer experience and service quality.

② Among the factors of "poor fruit quality," "lots of rotten fruit," "unripe fruit," and "large physical differences," it is possible that merchants may ship unripe fruit to prevent fruit from rotting during transportation. However, there are still many poor fruit quality and rotten fruit, causing consumers bad experiences. Additionally, a difference between the size of the fruit purchased by the consumer and the actual fruit size received causes consumer dissatisfaction.

The factors of "poor courier packaging" and "average fruit taste" play a significant role. Merchants often fail to pack the products properly, making them easily damaged during transportation and decreasing fruit quality. Poorly packaged fruits tend to fall easily, leading to a negative impact on their taste quality.

5.Conclusion

Based on the analysis results and many challenges faced by the Guangxi fresh fruit supply chain, the optimized recommendations in this paper are advanced as follow. First and foremost, there is a need to improve product quality inspection and monitoring for online fresh fruit vendors in the province of Guangxi. In order to guarantee product quality, intermediaries must simultaneously build long-lasting, stable cooperative relationships with suppliers in the country of origin. The second requirement is to satisfy customer demands for individualized services. To increase customers' desire to buy and improve user satisfaction and loyalty, retailers should offer various purchasing alternatives to suit the needs of different customers preferences. This involves offering a wide range of fruit varieties and introducing personalized services, like customized gift boxes and specialized packaging tailored to individual preferences.

Moreover, because fresh fruit is so distinctive, consumers

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have higher expectations for product quality and customer service. Businesses should establish a reliable after-sales service system, improve interaction and communication, respond quickly to customer issues and complaints, and offer satisfactory solutions. Finally, online vendors should improve their coordination with legislative and regulatory bodies. Ensuring that products are legal and compliant, avoiding the occurrence of underweight phenomenon, matching the images as closely as possible to the actual product, and improving the integrity are very important. Furthermore, there is a crucial need to enhance standards for cold chain logistics, bolster the capability for distributing fresh fruits, implement effective packaging preservation measures, regulate temperature and humidity, and optimize fruit packaging methods. Likewise, it is imperative to elevate the performance level of services provided by employees, enhance their business acumen, and ensure distribution. At the same time, staff must receive high-quality feedback and evaluations. In order to improve customer satisfaction with delivery services, it is essential to establish a logistics feedback platform, particularly on the transparency of logistics delivery information.

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