

Research on control of influencing factors of quality and safety of agricultural products on B2C e-commerce platform

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Abstract. In recent years, the quality and safety issues of agricultural products on B2C e-commerce platforms in China have become a new threat and concern, drawing widespread attention from the government and the public. This article aims to conduct an in-depth study on the factors influencing the quality and safety of agricultural products sold on B2C e-commerce platforms. First, various indicators are selected to construct a comprehensive indicator system for the factors affecting the quality and safety of agricultural products on B2C e-commerce platforms. Subsequently, factor analysis is applied to the 18 selected indicators using SPSS statistical software to derive a model for the influencing factors of quality and safety for agricultural products on B2C e-commerce platforms. Finally, based on the empirical analysis results, a comprehensive examination is conducted to assess the impact of each factor on the quality and safety of agricultural products on B2C e-commerce platforms. The empirical results indicate that the four major influencing factors, namely, production source, processing and manufacturing, warehousing and transportation, and regulatory measures, all play crucial roles in influencing the quality and safety of agricultural products on B2C e-commerce platforms.

Keywords: agricultural products, B2C e-commerce platforms, factor analysis.

1. Introduction

In recent years, the inspection results of agricultural products on B2C e-commerce platforms have been far from optimistic, consistently revealing various issues. People have become increasingly uneasy about purchasing agricultural products on B2C e-commerce platforms, indicating that there is still a lack of sufficient experience in the development of agricultural products in the B2C environment. The quality and safety of agricultural products on B2C e-commerce platforms are issues of great concern for both the government and residents[1]. Therefore, conducting research on the control factors influencing the quality and safety of agricultural products on B2C e-commerce platforms is not only able to meet the modern residents' desire for a healthy lifestyle but also becomes crucial for the development of agricultural products on B2C e-commerce platforms[2].

In the study of the supply chain for high-quality pork in supermarkets, S. Sun et al. employed the factor analysis method to establish a relevant evaluation indicator system. Using path analysis, H. Jin et al. identified correlations between the quality and safety issues of agricultural products and factors such as lax ingredient control, inadequate sterilization techniques, and equipment non-compliance[3]. B. Lei et al. constructed a Logit regression model and utilized customer evaluations of agricultural products, particularly fruits on Taobao and Tmall, as sample data. They verified that the delivery and packaging of fresh agricultural products impact consumer satisfaction with the quality and safety of agricultural products[4]. C. Liu et al. adopted a cross-analysis approach using matrix models to identify unhygienic processing environments, incorrect use of elements, and improper packaging as risk factors compromising food quality and safety[5]. S. Huang et al. utilized a combination of various case studies to examine agricultural product quality control behaviors, proposing three influencing factors affecting the quality assurance and control of agricultural products. Stringer M F et al. analyzed agricultural product quality and safety issues primarily through empirical analysis and on-site investigations, leading to the construction of relevant information databases[6]. Ruiz-Garcia L, in the analysis of agricultural product quality and safety issues, mainly employed the construction of analytical models to conduct comprehensive assessments, incorporating methods such as entropy in the process[7].

From the literature review above, it is evident that experts and scholars have employed various methods in the study of factors influencing the quality and safety of agricultural products[8]. These methods include empirical research, analytic hierarchy process, and the construction of indicator systems. This article focuses on a control study of the factors influencing the quality and safety of agricultural products on B2C e-commerce platforms. Initially, we construct an indicator system for the factors influencing the quality and safety of agricultural products on B2C e-commerce platforms. Subsequently, empirical methods are applied to conduct factor analysis on 18 indicators, resulting in the development of a model for the factors influencing the quality and safety of agricultural products on B2C e-commerce platforms. Finally, hypotheses are tested using regression analysis to examine the proposed factors, specifically evaluating the significant roles played by production source, processing and manufacturing, warehousing and transportation, and regulatory measures in influencing the quality and safety of agricultural products on B2C e-commerce platforms.

2. Index system construction

2.1. Index system of influencing factors of quality and safety of agricultural products on B2C e-commerce platform

The indicator system for factors influencing the quality and safety of agricultural products on B2C e-commerce platforms is presented in Table 1.

Table 1. Index system of influencing factors

Primary factor index	Secondary factor index
Production source	Soil quality Air quality Irrigation water quality Fertilizer use Pesticide application Seed and seedling quality Procurement channel Producer literacy
Processing and manufacturing	Processing environment Packaging material Three-dose Detection technique
Storage and transportation	Storage technology and equipment Transportation and equipment Logistics distribution
Regulatory measures	Regulatory standard Relevant policies and regulations Platform supervision measures

It can be seen from Table 1 that the index system of influencing factors of agricultural product quality and safety on B2C e-commerce platform includes 4 first-level indicators and 18 second-level indicators. The first-level indicators and the second-level indicators are respectively: production source (soil quality, air quality, irrigation water quality, fertilizer use, pesticide application, seed and seedling quality, procurement channels, producer education level); Processing and manufacturing (processing environment, packaging materials, use of three agents, testing technology), warehousing and transportation (storage technology and equipment, transportation technology and equipment, logistics distribution), regulatory measures (regulatory standards, relevant policies and regulations, platform regulatory measures).

2.2. Questionnaire design and data collection

1) The structure of the questionnaire

Based on the established indicator system, a questionnaire was designed to conduct a survey for a better assessment of the factors influencing the quality and safety of agricultural products on B2C e-commerce platforms. The formulation of this questionnaire was primarily achieved through a review of relevant literature[9]. Building upon the achievements of predecessors and considering the current state of quality and safety of agricultural products on B2C e-commerce platforms, the questionnaire was developed based on the main focus of this study. After a thorough comparison and organization, the initial questionnaire items were determined. Once the general content of the questionnaire was established, a pilot test was conducted. Based on feedback from the respondents, issues in the questionnaire design were identified, and necessary improvements were made to address deficiencies. Some items with low reliability were deleted or revised. The final research questionnaire was then confirmed, aiming for a more scientific and comprehensive exploration of the issues[10].

The questionnaire is primarily composed of two main sections. The first part, the core of the survey, assesses various factors influencing the quality and safety of agricultural products on B2C e-commerce platforms. This assessment is based on the degree of agreement, covering four dimensions: production source, processing and manufacturing, warehousing and transportation, and regulatory measures. Participants are asked to provide relatively objective responses to each question based on their own understanding. The second part of the questionnaire gathers information about the personal circumstances of the respondents. The five Arabic numerals (1-5) in the first part represent the respondent's level of agreement with the given questions. The numerical values increase from 1 to 5, indicating a higher level of agreement with the issues related to the influencing factors of quality and safety in B2C e-commerce platforms for agricultural products.

2) Distribution and recovery of questionnaires

The survey questionnaire was distributed to various individuals involved in the B2C e-commerce platform agricultural product supply chain, including consumers, intermediaries, and farmers. The distribution of the survey was conducted both online and offline. Online distribution involved inviting eligible individuals through various social media platforms[11]. Participants were encouraged to share the questionnaire with others in their network who met the criteria, thereby expanding the reach of the survey. Offline distribution included visits to local farmers and individuals involved in agricultural e-commerce to distribute and collect the survey questionnaires. A total of 455 questionnaires were distributed. After excluding invalid responses, the final dataset comprised 448 valid questionnaires. The response rate for this survey was 98.5%. (The criteria for a valid questionnaire were: 1) completeness with no unanswered questions, and 2) completion time exceeding 100 seconds)

3. Data analysis and hypothesis testing

3.1. Reliability analysis

The reliability analysis in the questionnaire aims to assess the reliability of the experimental results and is an indispensable and crucial step in the research process. It typically serves as the initial analysis of the collected questionnaires. In this study, Cronbach's Alpha coefficient is employed to indicate the reliability of the questionnaire. In practical research, if the Cronbach's Alpha coefficient is less than 0.7, it suggests a significant level of questionnaire error. A range of 0.7 to 0.8 signifies moderate reliability, while values exceeding 0.8 indicate high reliability and consistency with minimal questionnaire error. In this research, a threshold of 0.7 is set as the evaluation criterion. For the study to be meaningful, the Cronbach's Alpha coefficient should be greater than 0.7. The overall reliability is shown in Table 2.

Table 2. Reliability statistic

Cronbach's Alpha	Number of terms	Number of terms
0.895	18	Scale ideal

From Table 2, it is evident that the overall reliability of the scale is very high, indicating a high level of stability and consistency in the results. The Cronbach's Alpha coefficient is 0.895, which is close to 0.9, signifying that the scale is highly reliable with minimal questionnaire error. Next, reliability analyses were conducted separately for the variables of production source, processing and manufacturing, warehousing and transportation, and regulatory measures, as shown in Table 3.

Table 3. Reliability coefficient table

Measured variable	Number of terms	Cronbach's Alpha	Test result
Production source	8	0.910	Scale ideal
Processing and manufacturing	4	0.868	Scale ideal
Storage and transportation	3	0.819	Scale ideal
Regulatory measures	3	0.892	Scale ideal

From Table 3, it can be observed that the Cronbach's Alpha coefficients for the variables of production source, processing and manufacturing, warehousing and transportation, and regulatory measures are 0.910, 0.868, 0.819, and 0.892, respectively, all exceeding 0.8. The Cronbach's Alpha values for each dimension are quite appropriate, confirming the quality of the collected data. The robust reliability values indicate the soundness of the survey questionnaire and affirm the reliability of the divisions within each dimension[12]. The high level of reliability suggests that further data analysis can be conducted with confidence.

3.2. Factor analysis

1) Validity test

This study employed a measurement criterion of 0.7 for the Kaiser-Meyer-Olkin (KMO) value, meaning that if the KMO value is greater than or equal to 0.7, it indicates satisfactory validity, suggesting that the data is suitable for the intended analysis and is likely to yield good results[13]. Conversely, if the KMO value is less than 0.7, it implies that the validity is not particularly acceptable, and the alignment with expectations is relatively poor. Using the SPSS software, this paper conducted KMO measurements and Bartlett's test of sphericity for the dimensions of production source, processing and manufacturing, warehousing and transportation, and regulatory measures. The KMO value for the scale is 0.773, exceeding the 0.7 measurement criterion, indicating that factor analysis on this data is likely to yield favorable results. Additionally, the significance level for the Bartlett test is set at less than 0.01. From the table above, the Sig value is 0.000, which aligns well with the criteria, making it suitable for further analysis[14].

2) Extraction common factor

According to the results of the total variance explained, the eigenvalues for the features greater than 1 are 6.838, 2.686, 1.711, and 1.561, indicating the extraction of a total of 4 common factors. This preliminary alignment corresponds to the four dimensions delineated in this study. The explained variance values for components 1 to 4 are 28.618%, 16.133%, 13.884%, and 12.451%, respectively. Collectively, the four common factors in the total variance explained table account for 71.085% of the overall variance, surpassing the 60% measurement criterion. The scree plot corresponding to the main factors in the factor analysis is illustrated in Figure 1.

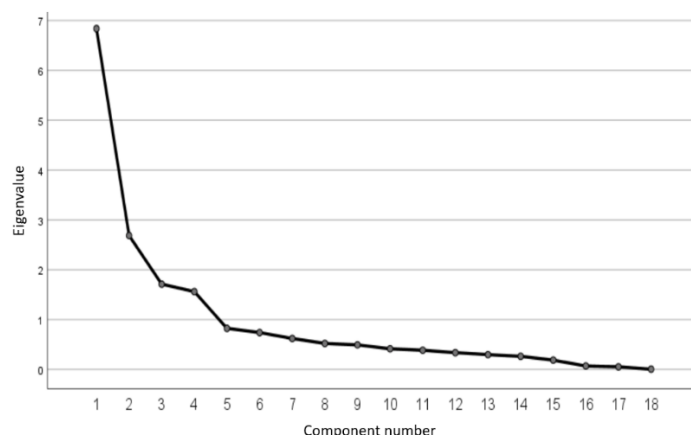


Figure 1. Main factor extraction lithotripsy map

The scree plot also indicates a noticeable incline in the earlier factors, and from the 5th factor onward, the curve gradually approaches a parallel line, suggesting a milder slope. This observation signifies that the first 4 factors already encompass a considerable amount of information, confirming the existence of four common factors with eigenvalues greater than 1.

The load matrix of 18 secondary indexes in the index system after rotation on the 4 main factors is shown in Table 4. It can be seen that there are 8 items with load value greater than 0.5 in factor 1, including soil quality, air quality, irrigation water quality, fertilizer use, pesticide application, seed and seedling quality, procurement channels, and producer education level. In factor 2, there are 4 items with load value greater than 0.5, including processing environment, packaging materials, use of three agents, and testing technology. In factor 3, there are 3 projects with load value greater than 0.5, including warehousing technology and equipment, transportation technology and equipment, and logistics distribution. In factor 4, there are 3 projects with a load value greater than 0.5, including regulatory standards, relevant policies and regulations, and platform supervision measures. Through exploratory factor analysis, it can be found that the scales of each variable in the survey questionnaire are reliable and the dimension structure is relatively consistent, which also indicates that the index system constructed in this paper can well measure the quality and safety of agricultural products on B2C e-commerce platform[15].

Table 4. The load matrix after rotation

Index	Component 1	Component 2	Component 3	Component 4
Soil quality	0.719			
Air quality	0.693			
Irrigation water quality	0.835			
Fertilizer use	0.741			
Pesticide application	0.831			
Seed and seedling quality	0.824			
Procurement channel	0.842			
Producer literacy	0.620			
Processing environment		0.586		
Packaging material		0.911		
Three-dose		0.731		
Detection technique		0.909		
Storage and equipment				0.826
Transportation and equipment				0.855
Logistics distribution				0.804
Regulatory standard			0.873	
Relevant policies and regulations			0.905	
Platform supervision measures			0.896	

3.3. Model construction

Based on the empirical analysis results above, it is evident that the factors influencing the quality and safety of agricultural products on B2C e-commerce platforms can be categorized into four aspects: production source, processing and manufacturing, warehousing and transportation, and regulatory measures[16]. The various indicators identified within these aspects can effectively serve as factors for evaluating whether agricultural products on B2C e-commerce platforms are of sufficient quality and safety. Utilizing the results of the factor analysis, a model for the factors influencing the quality and safety of agricultural products on B2C e-commerce platforms can be constructed. In this research model, the quality and safety of agricultural products on B2C e-commerce platforms serve as the dependent variable, while the four primary indicators act as independent variables, exploring how these independent variables impact the quality and safety of agricultural products on B2C e-commerce platforms. The constructed factor model is illustrated in Figure 2-5.

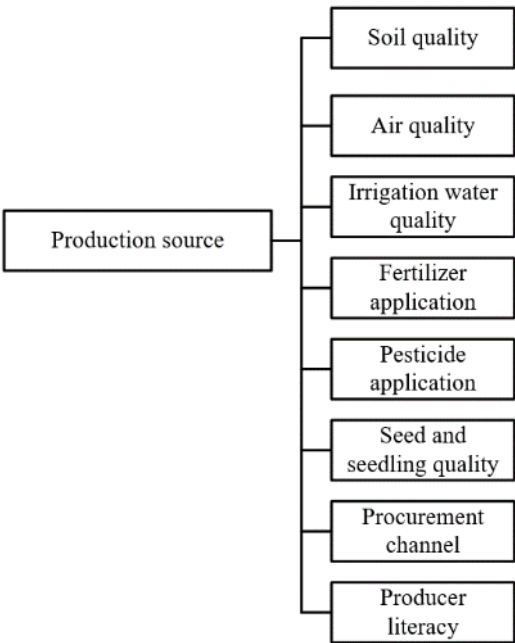


Figure 2. Production source factor model

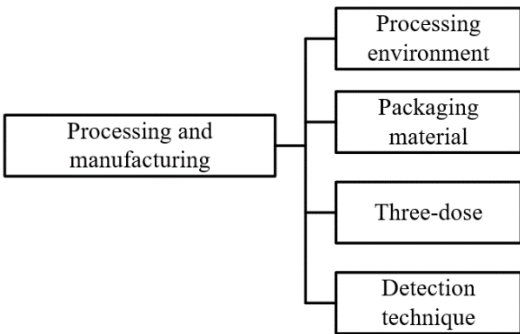


Figure 3. Manufacturing factor model

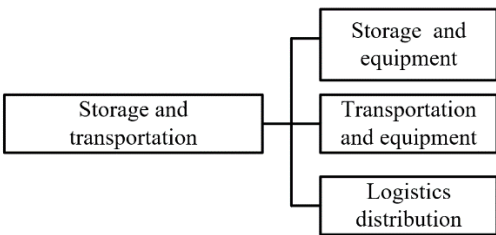


Figure 4. Storage and transportation factor model

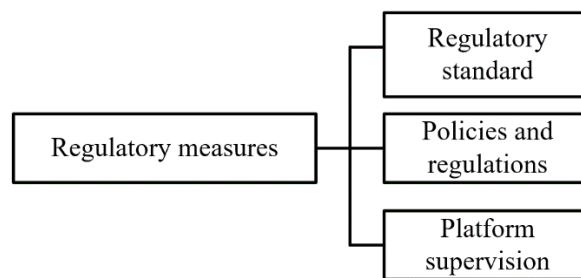


Figure 5. Regulatory measures factor model

4. Regression analysis

4.1. Multicollinearity detection

Multicollinearity means multiple correlations. The relationship between the independent variable and the dependent variable belongs to causation, which is a kind of high-level correlation. However, independent variables are not only correlated with dependent variables, but also may be correlated with other independent variables[17]. Such a relationship between independent variables belongs to this phenomenon, which is relatively common in regression analysis. If the multiple correlations are too strong, it means that different independent variables may explain the same type of change, leading to errors. Multivariate collinearity detection is mainly judged from the following aspects: the closer the feature root is to 0, the stronger the collinearity is; If the conditional index (CI) is greater than 30, it indicates the existence of multicollinearity. The closer the tolerance is to 0, the stronger the homolinearity is; the closer the tolerance is to 1, the weaker the homolinearity is. If the variance expansion coefficient value (VIF) is greater than 10, it is considered that there are multiple correlations between the variable and other variables. The specific analysis results are shown in Table 5.

As indicated in the table, the Condition Index (CI) values for the variables of production source, processing and manufacturing, warehousing and transportation, and regulatory measures are all less than 30. The tolerance values are 0.695, 0.675, 0.831, and 0.898, respectively, all greater than 0.5 and closer to 1. The Variance Inflation Factor (VIF) values are 1.438, 1.481, 1.203, and 1.114, respectively, all less than 10. Considering these various indicators, this study concludes that there is no evidence of multicollinearity among the variables of production source, processing and manufacturing, warehousing and transportation, and regulatory measures.

Table 5. Collinear statistics

Variable	Eigenvalue	Conditional index (CI)	Allowance	Variance expansion coefficient (VIF)
Production source	0.025	13.979	0.695	1.438
Processing and manufacturing	0.017	17.063	0.675	1.481
Storage and transportation	0.013	19.176	0.831	1.203
Regulatory measures	0.008	25.175	0.898	1.114

4.2. Model analysis

Using SPSS statistical software, an in-depth exploration of the constructed research model was conducted by taking production source, processing and manufacturing, warehousing and transportation, and regulatory measures as independent variables, and quality and safety as the dependent variable. The model was input into the software, and a multiple stepwise regression analysis was performed. The specific analysis results can be found in Tables 6 and 7.

Table 6. Model summary

Model	R	R square	Adjusted R square	Error in standard estimates
1	0.525 ^a	0.275	0.274	0.53389
2	0.569 ^b	0.324	0.321	0.51616
3	0.591 ^c	0.350	0.345	0.50696
4	0.601 ^d	0.362	0.356	0.50276

From Table 6, it can be observed that the adjusted R-squared value is 0.356. This indicates that the regression analysis results, using quality and safety as the dependent variable and production source, processing and manufacturing, warehousing and transportation, and regulatory measures as independent variables, can explain 35.6% of the total variability.

From Table 7, it is evident that processing and manufacturing enters the regression model first, indicating that it has the greatest impact on quality and safety. Subsequently, production source, warehousing and transportation, and regulatory measures enter the model in sequence. The regression equation derived from the analysis is as follows: Quality and Safety = 0.267 * Processing and Manufacturing + 0.226 * Production Source + 0.122 * Warehousing and Transportation + 0.106 * Regulatory Measures + 1.268. The regression coefficients for processing and manufacturing, production source, warehousing and transportation, and regulatory measures are 0.267, 0.226, 0.122, and 0.106, respectively. All regression coefficients are positive, indicating that production source, processing and manufacturing, warehousing and transportation, and regulatory measures all have a positive impact on the quality and safety of agricultural products on B2C e-commerce platforms. The significance test's Sig values are all less than 0.01, indicating that production source, processing and manufacturing, warehousing and transportation, and regulatory measures all have a significant impact on the quality and safety of agricultural products on B2C e-commerce platforms. The four main influencing factors are ranked in descending order of their impact: processing and manufacturing, production source, warehousing and transportation, and regulatory measures. All four independent variables—production source, processing and manufacturing, warehousing and transportation, and regulatory measures—have a significantly positive impact on the quality and safety of agricultural products on B2C e-commerce platforms, rejecting all null hypotheses and accepting all alternative hypotheses as proposed in the previous text.

Table 7. Coefficient ^a

Model	B	Standard error	Standardization coefficient Beta	t	Significance (sig)
(constant)	2.659	0.137		19.425	0.000
Processing and manufacturing(1)	0.422	0.032	0.525	13.004	0.000
(constant)	1.982	0.178		11.113	0.000
Processing and manufacturing(2)	0.309	0.037	0.384	8.297	0.000
Production source	0.256	0.045	0.262	5.665	0.000
(constant)	1.578	0.200		7.874	0.000
Processing and manufacturing(3)	0.278	0.037	0.346	7.456	0.000
Production source	0.229	0.045	0.234	5.091	0.000
Storage and transportation	0.147	0.035	0.170	4.155	0.000
(constant)	1.268	0.225		5.626	0.000
Processing and manufacturing(4)	0.267	0.037	0.331	7.168	0.000
Production source	0.226	0.045	0.231	5.074	0.000
Storage and transportation	0.122	0.036	0.141	3.376	0.001
Regulatory measures	0.106	0.037	0.116	2.902	0.004

5. Conclusions

This study aims to conduct an in-depth investigation into the factors influencing the quality and safety of agricultural products sold on B2C e-commerce platforms. Initially, a comprehensive indicator system for the factors affecting the quality and safety of agricultural products on B2C e-commerce platforms was established by selecting various indicators. Subsequently, factor analysis was performed on 18 selected indicators using SPSS statistical software to derive a model for the factors influencing the quality and safety of agricultural products on B2C e-commerce platforms. Finally, based on empirical analysis results, a comprehensive examination was conducted to assess the impact of each factor on the quality and safety of agricultural products on B2C e-commerce platforms. The empirical results indicate that the four major factors of production source, processing and manufacturing, storage and transportation, and regulatory measures are crucial for the quality and safety of agricultural products on B2C e-commerce platforms. During the research process, there may be aspects of the factors influencing the quality and safety of agricultural products on B2C e-commerce platforms that were not fully considered. Due to limitations in research capabilities, the understanding of this field may not be fully mature, leading to some shortcomings in the construction of the indicator system. Therefore, this study has certain limitations, and the model constructed may need further refinement, with results potentially not comprehensively covering all aspects of this domain.

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