

How Epidemic Closure and Value Appraisal Impact Cold Chain Products Adoption

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Abstract: From the perspective of epidemic control form, the work proposed a comprehensive resident behavior model of new cold chain food adoption and purchase in which foods' edibility, nutrition and fresh attributes are considered. In this study, two types of cold chain foods (Frozen Food) are selected as target foods for questionnaire survey. Structural equation models are established for two type frozen foods to explore how different epidemic control form impact residents' purchase behavior through the joint effect of value appraisal and the moderator of Intelligence Storage Center. This study contributes to consumer behavior literature by revealing how different epidemic control forms influence consumers' decision-making by affecting their perception of the nutrition and fresh attributes of the cold chain foods through labels center moderator. It provides a new knowledge and theories for entrepreneurs and marketers in the cold chain food industry and will be helpful for the supplier and marketing of cold chain foods in Chinese cold chain food markets.

1. Introduction

"From farm to table, branch to tongue", cold chain logistics connects the field and kitchen table, which is related to people's livelihood. In recent years, the change of consumption mode brought by the epidemic has pushed the development of cold chain logistics into a fast lane. Cold Chain for the Food (CCF) refers to the process, storage, transportation, distribution and retail of perishable food products until the hands of consumers after the purchase or fishing of perishable food products from the place of origin. In order to ensure the quality and safety of food and reduce losses, all the links of perishable food products are always under the necessary low temperature environment. Special supply chain systems to prevent pollution [1].

The cold chain applies to food products including: Primary agricultural products: vegetables, fruits; Meat, poultry, eggs; Aquatic products; Flower products. Processed food: frozen food; Poultry, meat, aquatic products and other packaged cooked food; Ice cream and dairy products; Fast food ingredients. Special merchandise: Medicine.

With the continuous development of the Internet era, the rapid development of the network promotes the prosperity of e-commerce, the fresh field of e-commerce and e-commerce development trend combined. Fresh is the most demanding category in e-commerce. Its 3% industry penetration rate and good market size still attract many investors to participate in it. The future development of fresh e-commerce is still considerable. Fresh e-commerce platforms represented by SF Preferred, Hema Fresh, Every Chou You xian, Tian Tian Orchard, Jingdong Home, etc., have their own industry resource advantages, making the market competition increasingly fierce.

In accordance with the requirements for the prevention and control of COVID-19 cases, closed prevention and control management has been implemented in places where confirmed patients live and work. With the change of epidemic prevention and control, the Settings and prevention and control measures of closed area, sealed area and prevention and control area can be adjusted dynamically in real time.

2. Literature Review

In this section, we retrospect the progress of Cold chain food adoption research, which is one of the hot area in Epidemic control form studies, while introduce some other important related work on the two points the study focuses, Epidemic control form and CCF, and CCF value.

2.1. Chain Food Adoption Research

In technology adoption studies, user's perception of the functionality of technology products is a core factor that influences the usage intention and behavior. Davis (1989) proposes the Technology Acceptance Model (TAM) that indicates that perceived usefulness and perceived ease of use have direct impact on attitude towards using, usage intention and actual use behavior [2]. To make up the limitation that TAM only focus on information system acceptance in work circumstances, Venkatesh and Davis (2000) and Venkatesh and Bala (2008) keep optimizing the TAM model and develop it to the TAM2 and TAM3 models [3-4]. Venkatesh (2003) integrates eight models into the Unified Theory of Acceptance and Use of Technology (UTAUT) including the main variables of performance expectancy, effort expectancy, social influence, facilitating conditions, and behavioral intention. Comparing with previous models, the UTAUT model provides significantly better accuracy when predicting user acceptance of new technologies [5]. Most recently, Venkatesh (2012) proposes a UTAUT2 by incorporating three constructs into UTAUT: hedonic motivation, price value and habit [6].

All existent research on technology acceptance focuses on the two aspects of "technology" and "users". When Cold chain foods become resident commodities which contain both food and epidemic attributes, the traditional technology acceptance theories become insufficient to explain residents' purchase behavior. This research attempts to make up the gap in this area.

2.2. Epidemic Control Form

Containment area means that the finding points, living points, working points, mobile points and surrounding areas of novel coronavirus positive cases are demarcated into containment areas [7]. Implement "closed isolation, stay at home, service door-to-door" management measures. Nucleic acid tests were performed on the first, fourth, seventh, tenth, and fourteenth days of confinement. People in the closed area are not allowed to leave the area except for medical treatment. Lockdown area refers to the residential sites, working sites, activity sites and surrounding areas of close contacts of positive cases and people at high risk of common exposure as lockdown area. The

implementation of “only in, no gathering” management measures. Nucleic acid tests were performed on the first, fourth, and seventh days of containment. Temporarily close the business places, chess and card rooms, activity rooms and other non - necessary cultural, sports, leisure and entertainment places. No one in the lockdown area is allowed to leave the area except for medical treatment [8].

The prevention and control area is based on the results of on-site epidemiological investigation, according to the situation, the surrounding area of the closed control area is divided into the alert area, the implementation of “two points (residential point - working point) line, not to leave the necessary” management measures [9]. One nucleic acid test was carried out within 24 hours. Home monitoring was conducted before the results were confirmed, and then the prevention and control measures were adjusted according to the situation.

2.3. Cold Chain Food Value

After rapid development, frozen food occupies an important position in the food market in just a few years and becomes a new star in the food industry. China's quick-freeze industry is in the growth stage with huge space for development. At present, the development of the industry focuses on overall expansion, and enterprises with scale and brand advantages will have obvious development advantages. Quick-frozen food is generally stored at a low temperature of -18°C $\sim -20^{\circ}\text{C}$, which can delay food deterioration and kill some bacteria in some food. It has the advantage of preserving the original quality of the food through low temperature refrigeration, without adding any preservatives and additives, and at the same time keeping the nutrition of the food to the maximum extent. It has the advantages of delicious, convenient, healthy, hygienic, nutritious and affordable raw food [10].

The variety of frozen food covers almost all aspects of food ingredients, providing more choices and possibilities for our table dishes. You know, if it weren't for frozen food, how would we be eating young corn and young peas all year round, or fat Australian cattle across the Pacific? After frozen food processing, it can reduce the activity of water in the food matrix, inhibit the activity of microorganisms and enzymes, slow down the speed of various chemical and biochemical reactions, slow down the speed of food decay, so as to maximize the original freshness, color, flavor and nutrition of natural food.

Frozen fruits and vegetables do not lose any more nutrients than fresh fruits and vegetables. Frozen fruits and vegetables are frozen at -18°C as soon as they are picked. At this temperature, the respiration of fruits and vegetables almost stops, and microorganisms cannot grow and reproduce, which in theory is more conducive to nutrient retention. Meat mainly provides protein and minerals. At extremely low temperatures, the protein and mineral machines do not change, so the nutritional value of frozen meat is hardly lost. These are the benefits of quick-frozen food [11].

According to the Food daily Research Institute's research on China's consumption trend, people have begun to pursue the freshness, health and nutrition of food, which meets the new mainstream of consumers' pursuit of fresh, nutrition, health and convenience for low-temperature food.

3. Conceptual Framework and Hypotheses

3.1. Research Concept

This study establishes a comprehensive technology acceptance model based on UTAUT theory, exploring the correlations between epidemic control form and residents behavior through the mediation of cold chain food edibility attributes, nutrition attributes, and fresh attributes. Though some literatures have mentioned the significant influence of epidemic control form and value

systems on consumer behavior, few of them have systematically investigated the cognitive process of such an influence.

3.2. Conceptual Framework

Based on literature review, the research model is constructed as below. In the model, resident epidemic control form is defined as independent variables, edibility attributes, nutrition attributes and fresh attributes are defined as intermediate variables, and purchase behavior are defined as dependent variables (see Figure 1).

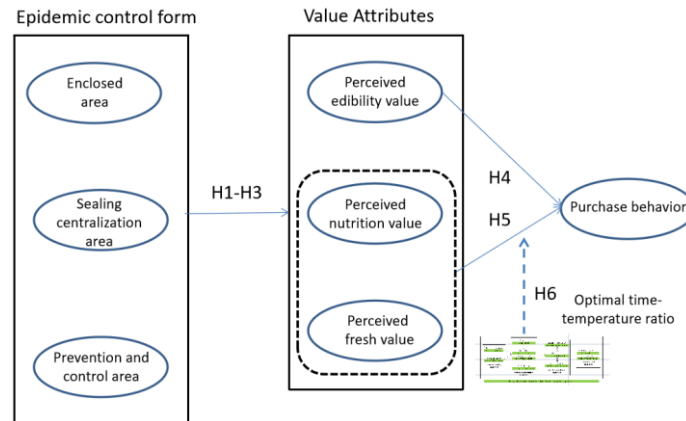


Figure 1: Research Conceptual Model

3.3. Hypotheses Development

Based on literature review and wide discussion with field experts, the research model and hypotheses are proposed focusing on the influence of epidemic control form on resident's purchase behavior through the mediation of resident appraisal on edibility, nutrition and fresh appraisals.

3.3.1. The Relationship between Epidemic Control form and Edibility Value Appraisal

Based on the relevant literature and theoretical exploration, we extract the relevant correlation relationship. Therefore, we propose the following hypotheses,

- H1. Epidemic control form are positively correlated with edibility appraisal.
- H1-1. Enclosed area is positively correlated with edibility appraisal.
- H1-2. Sealing centralization area is positively correlated with edibility appraisal.
- H1-3. Prevention and control area is positively correlated with edibility appraisal.

3.3.2. The Relationship between Epidemic Control Form and Nutrition Value Appraisal

Based on the relevant literature and theoretical exploration, we extract the relevant correlation relationship. Therefore, we propose the following hypotheses,

- H2. Epidemic control form are positively correlated with nutrition appraisal.
- H2-1. Enclosed area is positively correlated with nutrition appraisal.
- H2-2. Sealing centralization area is positively correlated with nutrition appraisal.
- H2-3. Prevention and control area is positively correlated with nutrition appraisal.

3.3.3. The Relationship between Epidemic Control form and Fresh Value Appraisal

Based on the relevant literature and theoretical exploration, we extract the relevant correlation

relationship. Therefore, we propose the following hypotheses,

H3-1. Enclosed area is positively correlated with fresh appraisal.

H3-2. Sealing centralization area is positively correlated with fresh appraisal.

H3-3. Prevention and control area is positively correlated with fresh appraisal.

3.3.4. The Relationship between Cold Food Value Appraisal and Purchase Behavior

Based on the relevant literature and theoretical exploration, we extract the relevant correlation relationship. Therefore, we propose the following hypotheses,

H4. Edibility value appraisal is positively correlated with purchase behavior.

H5-1. nutrition value appraisal is positively correlated with purchase behavior.

H5-2. Fresh value appraisal is positively correlated with purchase behavior.

3.3.5. The Relationship Intelligence Storage Center regulating between Food Added Value Appraisal and Purchase Behavior

Based on the relevant literature and theoretical exploration, we extract the relevant correlation relationship. Therefore, we propose the following hypotheses,

H6. Intelligence Storage Center is positively regulating between food added value Appraisal and Purchase Behavior.

3.4. Overview of Studies

Adoption research is required to focus on both "epidemic control form" and "value attributes". Therefore, we designed the study. In study, we obtain model product data by questionnaire and verify theoretical model by structural equation, we choose the survey for value cognition research. Then we explore how cold chain food value attributes cognition impacts adoption under epidemic control form to verify the self-developed value attributes scale. Meanwhile, as specific experiment is relatively straightforward and objective in researching different cold chain foods adoption, we choose specific foods as the technique. We explore and compare the causal relationship and verify the theoretical model. According to the food value and fresh value scale developed in the survey, we design the specific cold food analysis in order to explore the cause-and-effect relationship of epidemic control form, value appraisal and purchase behavior and the impact effect and compare the effect difference between different food value attributes.

4. Methodology and Empirical Results

The goal of study is testing theoretical models from the perspective of value attributes cognition. We collected 424 valid questionnaires via surveys, used SPSS for factor analysis and WarpPLS to build structural equation, judged if the theoretical model and assumptions were valid according to the path and significance, explored the relationship between value attributes and each construct, and validated the self-developed value attributes scale.

4.1. Participants and Apparatus

Participants: Before survey, face to face interviews are conducted with two groups of people (three persons each) to understand if the content and format of questionnaire are correctly and clearly stated, then the questionnaire are modified and finalized based on the feedback of the interview. Before handing out the questionnaire, the interviewees are trained to make sure they correctly understand the entire questionnaire and the survey procedure. Pilot test is carried out

during June 15rd to 29th, 2022 which collects 80 questionnaires. Based on data from the pre-test, the questionnaire is slight adjusted and the formal one for large scale survey is achieved. The formal survey is conducted during July 8th to 18th in Tianzijie quarters in Jinjiangqu area, Chengdu and Qiliping quarters in Hongya area, Meishan. Due to the different conditions in the isolated areas, in order to collect real primary data, we paid for the help of relevant epidemic service personnel and support personnel. The interviewees are selected randomly from residents in the quarters who are about to buy cold chain products. The formal survey collects 584 questionnaires, out of which 422 effective ones.

Apparatus: When analyzing the collected data, we used SPSS and WarpPLS3.0 and followed two-step procedure suggested by Anderson and Gerbing (1988). First, we examined the measurement model to measure convergent and discriminant validity by SPSS. Then, we examined the structural model to investigate the strength and direction of the relationships among the theoretical constructs by WarpPLS 3.0.

Selection of Foods: In this study, cold chain products is selected as target product for questionnaire survey. Cold chain products is chosen as target because it not only has foods, but also is frozen food featured with constant temperature.

4.2. Measures Design and Procedure

Design. Likert 5 point measure is adopted in questionnaire survey, with 1 standing for completely not agree (or the least important) and 5 standing for completely agree (or the most important), in order to compare the result of different scales [12]. The detailed questionnaire is seen in appendix.

4.2.1. Epidemic Control Form

In this study, we develop the Chinese consumers' lifestyle scale by referring Wells' AIO scale and Chuyajie's Chinese epidemic control form which is the first comprehensive epidemic control form scale for Chinese people [13]. The epidemic control form scale is composed of 9 items.

4.2.2. Value Attributes

(1) Food edibility value attributes. In this study, we measure food value attributes based on the agricultural food model, we adopt Ma's perceived edibility and perceived nutrition scales (2013) to measure the food value attributes of cold chain foods [14]. 6 items are included.

(2) Fresh value attributes. In this study, we design the fresh value measure by referring to Zhangjun's fresh value scale (2008) and taking into consideration the fresh characteristics of cold chain foods [15]. The scale contains 3 items.

4.2.3. Purchase Behavior

2 items are used to measure resident's purchase behavior.

This study uses SPSS17.0 to conduct factor analysis on epidemic control form, value attributes, usage intention and purchase behavior.

Procedure. First, measurement model by SPSS: Cronbach's alpha scores indicated that each construct exhibited strong internal reliability. Convergent validity was assessed based on the criteria that the indicator's estimated coefficient was significant on its posited underlying construct factor. We evaluated the measurement scales using the three criteria [16] suggested by Fornell and Larcker(1981): (1) All indicator factor loading (λ) should be significant and exceed 0.5; (2) Construct reliability should exceed 0.8; (3) Average variance extracted (AVE) by each construct

should exceed the variance due to measurement error for the construct (e.g. AVE should exceed 0.5). All (λ) values in confirmatory factor analysis of the measurement model exceeded 0.5 and were significant at $p=0.001$. Composite reliability of constructs ranged from 0.8 to 0.9. AVE, ranging from 0.510 to 0.622, was greater than the variance due to measurement error. Therefore, all three conditions for convergent validity were met.

Second, Discriminant validity: Discriminant validity assesses the extent to which a concept and its indicators differ from another concept and its indicators (Bagozzi et al., 1991). According to Fornell and Larcker (1981), (1) The correlations between items in any two constructs should be lower than the square root of the average variance shared by items within a construct. (2) Item load of each variable should be greater than the cross load of any other variables. As shown in Table 1, the square root of the variance shared between a construct and its items was greater than the correlations between the construct and any other construct in the model, satisfying the first condition. All diagonal values exceeded the inter-construct correlations, which met the second condition. Therefore the results confirm that our instrument has satisfactory construct validity.

Table 1: Discriminant validity

Construct	ECF	EVA	NVA	FVA	PB
ECF	(0.721)				
EVA	0.108	(0.691)			
NVA	0.197	0.199	(0.749)		
FVA	0.305	0.219	0.136	(0.789)	
PB	0.028	0.226	0.054	0.115	(0.785)

Note: All correlations significant at $p < 0.05$ except where noted. Diagonal elements are square roots of average variance extracted.

Table 2: Variable VIFs value

Index(VIF)	EVA	ECF	NVA	FVA
EVA	1.229			
NVA	1.208			
FVA	1.216			
PB	1.121	1.008	1.155	1.142

Table 3: Full Collin. VIFs value

Index	Model
APC	APC=0.275, $p < 0.001$
ARS	ARS=0.287, $p < 0.001$
AVIF	AVIF=1.1225, Good if < 5

Third, Multicollinearity: According to Table 1, the correlation of all the components are relatively low, as the maximum is 0.305 (ECF and FVA). In order to determine whether there was linear effect, we checked whether the output of PLS contained collinearity prompt. The results showed that the no collinearity existed in the entire model. Potential collinearity problems could be further examined in the regression analysis. Variance inflation factor (VIF), which means the extent each variable explained by other variables, is a common inspection method of collinearity problems analysis in the regression (Hair et al., 1998). According to the criteria, VIF should be less than or equal to 5 [17] (i.e. tolerance > 0.1) (Asher, 1983; Hair et al., 1998). The model analysis showed that, VIFs and Full Collin. VIFs were both less than 5 (see Table 2 and Table 3), which demonstrated that no collinearity existed in the model.

Finally, validation of the theory and hypothesis by structural equation model: We observed

whether the goodness of fit matched the conditions, and validated the theoretical models and assumptions depending on the path coefficients (β) and significance(p) of the SEM model.

4.3. Framework and Products

Search Framework. In the study model, epidemic control form is defined as independent variables, Food value appraisal (edibility and nutrition), nutrition value appraisal, fresh value appraisal are defined as intermediate variables, and purchase behavior are defined as dependent variables. The three value appraisal dimensions (edibility and nutrition, fresh) are evaluated by multiplying the joint effect of importance of attributes and perceived values (see details in 4.5) as mediation factors. Two types of cold chain foods are selected for empirical research.

Selection of Products. In this study, two types of cold chain foods are selected as target products for questionnaire survey. Before the formal survey, interviews are done with experts and sales people in Tianzijie quarters in Jinjiangqu area, Chengdu and Qiliping quarters in Hongya area, Meishan to understand the main types of cold chain foods people buy and the major motives that make them buy. To improve the efficiency of survey, foods with high market share that can reflect different resident types are selected: fruit and fish.

4.4. Measures Design

Design. In order to compare the result of different scales, we make the value appraisal measure.

Value appraisal. In this study, we innovatively propose a new methodology of value appraisal, which is composed of two components, namely, perceived importance and perceived value. Yufei Yuan (2012) proposes in his research on mobile devices loss behavior that threat assessment can be evaluated by multiplying two key factors, namely perceived damage and perceived importance. Similarly, in this research, we classify the questionnaire questions into different sections to measure value appraisal [18] (perceived importance and perceived values). The calculation of value appraisal is shown as below, value appraisal description is Shown in Table 4.

$$VA_i = \left(\frac{PI_i}{5} \right) \times PV_i ; i=1,2,3,4,5 \quad (1)$$

VA=Value Appraisal; PI=Perceived Importance; PV=Perceived Value;

Table 4: Value Appraisal Description

Value Appraisal	$(PI/5) \times PC$
Edibility Appraisal	$(\sum \text{Imp Edibility}/5) \times \sum \text{Per Edibility}$
Nutrition Appraisal	$(\sum \text{Imp nutrition}/5) \times \sum \text{Per nutrition}$
Fresh Appraisal	$(\sum \text{Imp Fresh}/5) \times \sum \text{Per Fresh}$

This value appraisal study also uses SPSS17.0 to conduct factor analysis on epidemic control form, value appraisal and purchase behavior.

4.5. Moderator Variable

Cold chain food includes primary agricultural products: vegetables, fruits, meat, poultry, eggs, aquatic products, flower products. Processed food: frozen food; Poultry, meat, aquatic products and other packaged cooked food; Ice cream and dairy products; Fast food ingredients. Special merchandise: Medicine.

Cold chain logistics should follow the “3T principle”: the final quality of products depends on

the storage and circulation time, temperature and product tolerance of the cold chain. The "3T principle" points out the relationship between the time allowed for the quality of refrigerated food and the product temperature. The cold chain logistics center is constructed and positioned in three types of warehouses: low temperature warehouse (-25-18°C), high temperature warehouse (0°C-4°C) and constant temperature warehouse (10°C-15°C).

Intelligence Storage Center performs algorithm matching according to the input cold-chain food labels and epidemic control area labels, and gradually performs iterative operation according to more input labels to realize the construction and iterative update of the smart label library, and ensure the automation and intelligence of label data in the Intelligence Storage Center.

4.5.1. Economic model

$y=f(x_1,x_2,x_3,x_4,x_5,\dots, x_p)$, where: y = optimal time-temperature ratio in the epidemic area, x_1 = food stored and circulated, x_2 = food temperature stored and circulated, x_3 = time of storage and circulated, x_4 = location of storage and circulated, x_5 = epidemic cycle label, x_6 = regional impact label, x_7 = average housing price label, x_8 = regional market label...

4.5.2. Econometric model

The basic ant colony system is the basis of the intelligent algorithm of cold chain logistics. Therefore, an adaptive ant colony algorithm based on regulating pheromone volatility proposed by L. M. Gambardella and M. Dorigo is introduced here.

$y= \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \dots + \beta_p x_p + \varepsilon$, where: $\beta_0, \beta_1, \beta_2, \dots, \beta_p$ is the parameter and ε is the error value.

$$\rho(t) = \begin{cases} 0.95\rho(t-1), & \text{IF } 0.95\rho(t-1) \geq \rho_{\min} \\ \rho_{\min}, & \text{Other} \end{cases}$$

This moderator study uses Eviews11.0 to conduct model analysis on Intelligence Storage Center input and output.

5. Empirical Results

5.1. Exploratory Factor Analysis

In this study, factor analyses are conducted to evaluate the research construct and improve the quality of the measurement scales.

The questionnaire of value appraisal is composed of two sections, the first section is about residents' general perceived importance of food attributes, and the section is about perceived value of specific type of cold chain foods. The factors of perceived importance are in accordance with the factors of perceived values, therefore we only conduct exploratory factor analysis on perceived importance.

Table 5 shows the result of exploratory factor analysis. For Epidemic control form scale, the KMO is 0.882, higher than 0.6(Kaiser & Rice, 1974); and other KMOs are all higher than 0.6. The result of Bartlett test of Sphericity declines the non-relevance assumption between variables, therefore satisfies prerequisite for factor analysis (Shown in Table 5). In exploratory factor analysis, we conduct orthogonal rotation to extract three key factors for Epidemic control form, one factor for each perceived importance element (Shown in Table 6). The loadings for the measurement items on related factors are greater than the benchmark of 0.5 (Hair et al.1998) and the cumulative variance contribution rates are all higher than 50%.

Table 5: KMO and Barlett's Tests on Epidemic control form and Perceived Importance Scales

Scales	Kaiser-Meyer-Olkin KMO	Barlett's Test of Sphericity		
		Approx. Chi-Square	Df	Sig
Epidemic control form	0.882	4428.962	36	0.000
EAV	0.651	252.796	3	0.000
NAV	0.596	53.440	3	0.000
FAV	0.629	172.195	3	0.000

Table 6: Exploratory Factor Analysis of Epidemic control form and Perceived Importance

Epidemic control form	FL	Ev	C α	Ed (%)	Cvc (%)
Factor1: EA		2.627	0.933	29.185	91.275
EA1: ***	0.830				
EA2: ***	0.830				
EA3: ***	0.830				
Factor2: SCA		2.809	0.958	31.213	31.213
SCA1: ***	0.945				
SCA2: ***	0.945				
SCA3: ***	0.943				
Factor3: PCA		2.779	0.964	30.877	62.090
PCA1: ***	0.865				
PCA2: ***	0.860				
PCA3: ***	0.854				
Perceived Importance	FL	Ev	C α	Ed (%)	Cvc (%)
Factor 1: Imp of EAV		1.959	0.712	16.327	16.327
EAV1: ***	0.811				
EAV2: ***	0.786				
EAV3: ***	0.700				
Factor 2: Imp of NAV		1.424	0.451	11.869	57.539
NAV1: ***	0.759				
NAV2: ***	0.694				
NAV3:***	0.533				
Factor 3: Imp of FAV		1.774	0.642	14.786	31.113
FAV1: ***	0.813				
FAV2: ***	0.757				
FAV3: ***	0.690				

In the Epidemic control form scale, according to the content of items, the first Epidemic control form factor reflects the requirements of confirmed COVID-19 cases prevention and control and the degree of closed prevention and control management, therefore it is named as "EA"; the second factor is named as "SCA"; the third factor is named as "PCA".

In the perceived importance scale, according to the content of items, the first factor reflects that using the foods will improve one's life performance, therefore it is named as "importance of EAV"; the second factor is named as "importance of NAV"; the third factor is named as "importance of FAV".

5.2. Confirmatory Factor Analysis

As the second section of questionnaire is about value appraisal for three specific types of cold chain foods, namely fruit and vegetable, we conduct confirmatory factor analysis for fruit model and vegetable model respectively. The CR, AVE, VIF(variance inflation factor) coefficients of the construct variables for fruit and vegetable models are shown in Table 7.

Table 7: CR, AVE, Cronbach's α , VIF in fruit and vegetable Models

Construct	Enclosed area	Sealing centralization	Prevention control area	EAV	NAV	FAV	BB
Cronbach α	0.933	0.958	0.964	1.000	1.000	1.000	1.000
AVE	0.882	0.922	0.933	1.000	1.000	1.000	1.000
CR	0.957	0.973	0.977	1.000	1.000	1.000	1.000
VIF-fruit	5.318	3.663	4.549	1.543	4.444	2.858	6.077
VIF-vegetavle	4.821	9.974	3.775	1.582	4.397	2.523	8.075
No.items	3	3	3	3	3	3	2

In fruit and vegetable models, the loading of measured variables are higher than 0.7 (Nunnally and Bernstein 1994) and are significant ($P < 0.00$); AVE coefficients for all factors are higher than 0.5 (Fornell and Larcker 1981); CR coefficients of all factors are higher than 0.8 (Johnston and Warkentin, 2010); therefore PLS analysis result shows that the measurement scales reach satisfactory level of convergent validity [16].

As indicated in the internal correlations among structural variables, the highest construct correlation for fruit and vegetable models is 0.846 and 0.842 respectively, while the lowest square root of AVE is 0.939. The item loading on their respective constructs are greater than their cross loading on other constructs. Thus, the results demonstrate a satisfactory level of discriminant validity.

Finally, scale reliability is assessed by composite reliability values (CR) which should be greater than .70. As shown in Table 7, the lowest CR value is 0.957, and the composite reliability values of all the constructs are acceptable. Thus, confirmatory factor analyses of fruit and vegetable models are all satisfied.

5.3. Structural Model

In this study, we use WarpPLS 3.0 to conduct structural equation model test to explore how epidemic control form impact residents' appraisal of cold chain food edibility value, nutrition value and fresh, and consequently impact their usage intention and purchase behavior.

In PLS structural equation modeling, we multiply average perceived importance and average perceived value to achieve the result of value appraisal. The data of residents epidemic control form and purchase behavior is acquired from survey questionnaires. And structure equation model analyses are conducted for two type of cold chain foods respectively.

5.3.1. SEM For tomato

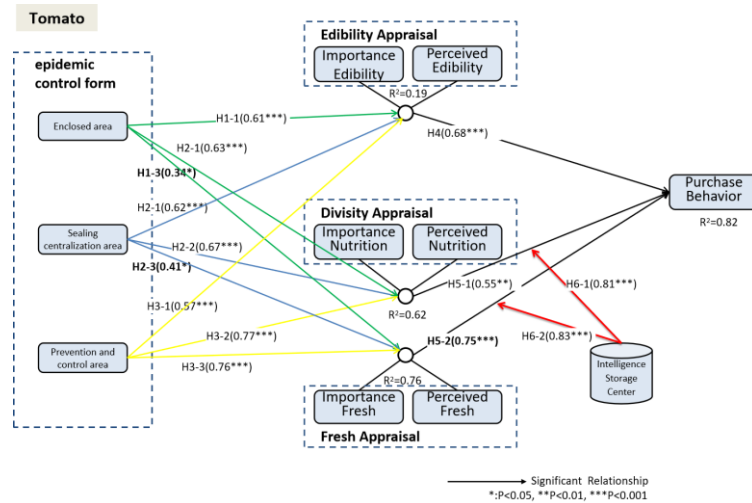


Figure 2: SEM for Tomato

Structural equation model analysis for tomato (see Figure 2) shows that, ① epidemic control form have significant correlations with residents' value appraisal. “Enclosed area” ($\beta = 0.61$, $P < 0.001$), “Sealing centralization area” ($\beta = 0.62$, $P < 0.001$) and “Prevention and control area” ($\beta = 0.57$, $P < 0.001$) are significantly correlated with edibility appraisal; “Enclosed area” ($\beta = 0.63$, $P < 0.001$), “Sealing centralization area” ($\beta = 0.67$, $P < 0.001$) and “Prevention and control area” ($\beta = 0.77$, $P < 0.001$) are significantly correlated with nutrition appraisal; “Prevention and control area” ($\beta = 0.76$, $P < 0.001$) are significantly correlated with fresh appraisal; and “Enclosed area” ($\beta = 0.36$, $P < 0.05$) and “Enclosed area” ($\beta = 0.41$, $P < 0.05$) are significantly correlated with fresh appraisal. ② Residents' value appraisals have significant correlations with their purchase behavior. ③ Intelligence Storage Center is positively regulating between food added value Appraisal and Purchase Behavior. ④ In the structural equation model for Tomato, the R² value of purchase behavior is 82%. The model satisfactorily explains residents' purchase behavior of tomato.

5.3.2. SEM For Fish

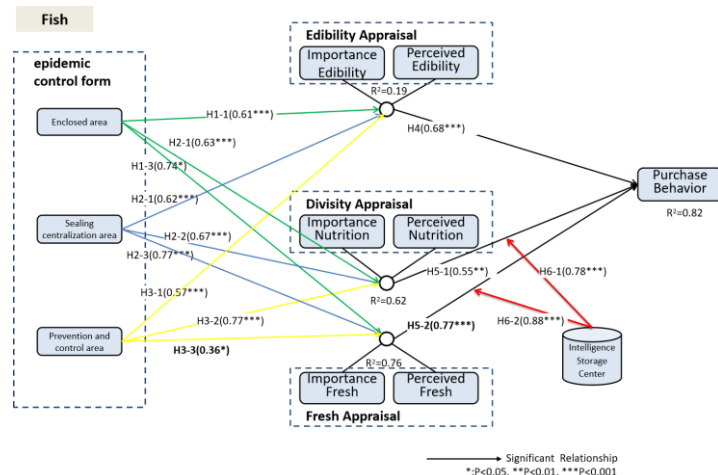


Figure 3: SEM for Fish

Structural equation model analysis for Fish (see Figure 3) shows that, (1) epidemic control form have significant correlations with residents' value appraisal. "Enclosed area" ($\beta=0.61$, $P<0.001$), "Sealing centralization area" ($\beta=0.67$, $P<0.001$) and "Prevention and control area" ($\beta=0.67$, $P<0.001$) are significantly correlated with edibility appraisal; "Enclosed area" ($\beta=0.63$, $P<0.001$), "Sealing centralization area" ($\beta=0.67$, $P<0.001$) and "Prevention and control area" ($\beta=0.77$, $P<0.001$) are significantly correlated with nutrition appraisal; "Prevention and control area" ($\beta=0.36$, $P<0.05$) are significantly correlated with fresh appraisal; and "Enclosed area" ($\beta=0.74$, $P<0.001$) and "Enclosed area" ($\beta=0.77$, $P<0.001$) are significantly correlated with fresh appraisal. (2) Residents' value appraisals have significant correlations with their purchase behavior. (3) Intelligence Storage Center is positively regulating between food added value Appraisal and Purchase Behavior. (4) In the structural equation model for Fish, the R² value of purchase behavior is 82%. The model satisfactorily explains residents' purchase behavior of fish.

5.4. Analysis Result

In this study, the average path coefficient (APC), average R-squared (ARS) and average variance inflation factor (AVIF) are observed to check the goodness of fit of the structural equation models. The APC and ARS coefficients for the three models are all significant ($P<0.001$) and AVIF values are lower than 5, indicating that the three models have satisfactory goodness of fit. (Shown in Table 8).

Table 8: Model fit indices and P values

Model	Tomato	Fish
APC	APC=0.246, $P<0.001$	APC=0.246, $P<0.001$
ARS	ARS=0.694, $P<0.001$	ARS=0.635, $P<0.001$
AVIF	AVIF=2.602,	AVIF=2.594

By observing the significant correlations between variables and R squared values, we find that in the two models, the R squared values of purchase behavior are all higher than 65%, exceeding the minimum benchmark of 60% (Falk and Miller 1992), indicating that all the two models have satisfactory explanatory power.

6. Discussion and Implications

6.1. Conclusion

This study establishes an epidemic control form-oriented new CCF acceptance model for Chinese residents, validates Chinese epidemic control form scale, and reveals how epidemic control form impact Chinese residents' perception of CCF edibility, nutrition and fresh attributes consequently impact residents' purchase behavior of Cold chain food.

Through structural equation model analyses of the two cold chain foods, we achieve the following findings.

(1) The result indicates that residents in epidemic control form such as Enclosed area、 Sealing centralization area and Prevention and control area all care for food edibility and nutrition while residents in epidemic control form such as Enclosed area, Sealing centralization area care less for food fresh but Prevention and control area pay more attention on other attributes such as food fresh.

(2) Residents' appraisals of food edibility, nutrition and fresh are positively correlated with purchase behavior, indicating that the edibility, nutrition and fresh attributes are three key aspects that residents will consider when deciding to purchase the food or not.

(3) Intelligence Storage Center is positively regulating between food added value Appraisal and

Purchase Behavior, indicating that the Intelligence Storage Center can play important role in cold chain food service.

(4) Fresh appraisal is less positively correlated with the purchase behavior of tomato food. It indicates that residents with Enclosed area and Sealing centralization area concern less about fresh attribute and are more possibly attracted by food with fresh advantages. Meanwhile in fish food, Prevention and control area concern less about fresh attribute.

6.2. Theoretical Contribution

(1) This study reveals the resident commodity attributes and characteristics of new Cold chain foods. Cold chain foods are not only general food in home but also special foods for residents in epidemic control form which contain resident commodity attributes of nutrition and fresh that directly affect residents' purchase behavior.

(2) This study innovatively introduces epidemic control form variables into resident cold chain food acceptance model. Previous technology acceptance theories used to only focus on individual and technological factors. This study for the first time comprehensively consolidates the three key attributes of cold chain foods, investigate food acceptance behavioral model from epidemic control form resident's perspective, innovatively connect marketing research approaches and technology acceptance theories, and apply epidemic control form system to explain cold chain food acceptance and purchase behavior of Chinese residents in epidemic situation.

6.3. Managerial Implications

This study provides a useful tool for consumer or resident identification, market segmentation, product positioning and provides an effective approach for marketers or supplier to design market strategy for cold chain foods.

(1) Marketers can design agriculture or family products and make market positioning strategies according to consumers' or residents' epidemic control form. This study offers a new approach for marketers to understand consumers and design cold chain foods more effectively.

(2) Based on the epidemic control form perspective, companies can design marketing strategies, cold chain layout and Cold chain community point service to highlight CCF advantages in edibility, nutrition and fresh attributes, improve overall food service and satisfaction ability, and realize parallel development in food quality and food market presence.

6.4. Limitations and Further Research

Due to time and resource constraints, this study still have some limitations that could be developed in future research.

First, the samples for empirical research come from Chengdu and Meishan, which confines the sample categories and geographical coverage and limits the universality of the findings. Future research can cover larger scope of samples and increase the volume of samples.

Secondly, this study only takes two cold chain foods as research objectives. Residents' purchase behavior may vary when the foods are different. Future research can look into other CCF foods, compare the results, adjust the models, and improve the universality of the findings.

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References

- [1] Liujie and Songxi. *Current situation and development countermeasures of cold chain logistics of Fresh agricultural products*. *China Agricultural Resources and Regional Planning*, 2016, 37 (3): 184-186, 232.
- [2] Davis, F.D. (1989). "Perceived usefulness, perceived ease of use and user acceptance of information technology", *Mis Quarterly*, Vol. 13, No. 3, 319-340.
- [3] Venkatesh, V., and Davis, F. D. (2000) "A Theoretical Extension of the Technology Acceptance Model: Four Longitudinal Field Studies," *Management Science*, Vol. 46, No. 2 (Feb., 2000), 186-204.
- [4] Venkatesh, Hillol Bala. *Technology Acceptance Model 3 and a Research Agenda on Interventions*. *Decision Sciences*, 2008, 39 (2): 273-315.
- [5] Venkatesh, V., Morris, M.G., Davis, G.B., and Davis, F.D. (2003), "User Acceptance of Information Technology: Toward a Unified View", *MIS Quarterly*, Vol.27, No.3, 425-478.
- [6] Venkatesh, V., and Davis, F. D. (2012), "A Model of the Antecedents of Perceived Ease of Use: Development and Test", *Decision Science*, Vol.27, Issue 3, 451-481.
- [7] Zhangshuli, *Some Major Issues of National Medium and Long Term Economic and Social Development Strategy*. *Qiushi*, 2020 (21): 4-10.
- [8] Xing Pengfei, Li Xinxin. *Research on the formation mechanism and guidance strategy of online public opinion in the prevention and control of major epidemic: Based on the qualitative analysis of online public opinion text during the COVID-19 epidemic*. *Journal of Information*, 2020, 39 (7): 67-74, 158.
- [9] Wu X, Zhang Y. *Management and control of floating population under the COVID-19 epidemic combined with community governance*. *Nanjing Social Sciences*, 2020 (3): 21-27.
- [10] Huang Fu Hongjiao, Chen Likai, Peng Hao, et al. *Research on problems and countermeasures of cold chain logistics of agricultural products -- A case study of Z Company*. *Journal of Anhui Agricultural Sciences*, 2019, 47 (12): 194-196.
- [11] Xu Y Y, Yao G X, Liu P X, et al. *Application of metabolomics in the detection and analysis of nutritional quality of agricultural products*. *Scientia Agricultura Sinica*, 2019, 52 (18): 3163-3176.
- [12] Shan Youcheng, Li Minqiang, Zhao Hong. *Customer Satisfaction Index Model and evaluation system for customer Relationship Management*. *Journal of Tianjin University (Social Science Edition)*, 2010, 12 (2): 119-124.
- [13] Chu Yajie, Lu Ye, Shen Fei. *Public knowledge and practice in China under the COVID-19 epidemic: An empirical study based on the National Public Science Cognition and Attitude Survey*. *Journalist*, 2020 (5): 3-13, 96.
- [14] MA Z M. *Scientific cooking -- effectively exerting the edible value and nutritional value of food*. *Management Science*, 2013 (22): 298-298.
- [15] Zhang J. *Research on rapid detection method of freshness of freshwater fish based on complex impedance characteristics and electronic nose*. *Hubei: Huazhong Agricultural University*, 2008 (15): 66-121.
- [16] Fornell, C. and Larcker, D.F. (1981), "Evaluating structural equation models with unobservable variables and measurement error", *Journal of Marketing Research*, Vol. 18 No. 1, 231-411.
- [17] Hair et al., *Intellectual capital: an exploratory study that develops measures and models*. *Management Decision*, 1998 (9): 109-235.
- [18] Yuan, Y.F., (2012) *Understanding User Behavior in Coping with Security Threats of Mobile Device Loss and Theft*, *International Conference on Information Systems*. 15 (8): 224-353.