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Identifying the critical factors affecting consumer's seeking food safety information behavior—Based on fuzzy DEMATEL method

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ABSTRACT

Based on the system of 17 factors affecting consumer's seeking food safety information behavior, fuzzy set theory and the decision-making trial and evaluation laboratory (DEMATEL) method were used to discover the factors' attributes and their relations, and then 7 critical factors among the system were identified, including consumers' education level, the degree of attention to food safety, consumer attention to health, the perceived risk of food safety, product knowledge, food brands, food certification of quality. According to the conclusion, enterprises should strengthen product quality and brand construction, and promote food safety certification.

KEYWORDS

Food safety information; Critical factors; Fuzzy set theory; DEMATEL; Consumer.

INTRODUCTION

Since 2008, the severe food safety accidents such as "Sanlu Milk Powder", "clenbuterol", "gutter oil" and "crash chicken" have frequently happened. The attention of the domestic mass to food safety risks reaches the unprecedented extent. "2011-2012 China Dietary Safety Report" [1] points out that 80.4% of respondents are lack of the safety sense for the current food safety conditions. Most respondents think that the current food safety conditions are worse than it in the past. Now food safety risk gradually becomes one of the most severe social risks in China. Wu Linhai, a risk prevention and control expert, pointed out that the asymmetric consumer's food safety information is the root reason to lead to food safety risk [2]. Although the governments and enterprises assume the social responsibility to actively publish food safety information, consumers play more important roles in solution of foods safety risks caused by asymmetric information. The consumers should search, analyze and use the food safety information to make an accurate decision on the inherent quality and value level of foods. So improving consumer's capability of searching and using the food safety information is one effective means to improve risk identification and prevention level.

Domestic and foreign scholars have conducted much research on consumer's information search behavior and influence factors from different views. Based on past research achievements, we constructed the influence factor system for consumer's search behavior of food safety information, and then attempted to analyze attributes and mutual relations of influence factors of consumer's search behaviors for food safety information by fuzzy set theory and the decision-making trial and evaluation laboratory (DEMATEL) method. The aim of this study was to identify the key factors to affect consumer's search behavior of food safety information, and propose purposeful prevention measures. We expect that the research achievement can serve for decision in safety information publication of food enterprises and the food safety supervision of governments.

REFERENCE REVIEW AND INFLUENCE FACTOR SETUP

Reference review

Domestic and foreign scholars have applied multi-subject theory and method to conduct empirical research and theoretical discussion on the consumer's information search behavior, and its influence factor and action mechanism from different views. Sundaram and Taylor studied information search behavior of consumers in network shopping, which pointed out that the consumer's age, education degree, income level and time pressure would significantly affect information search behavior of the consumers [3]. Manafo and Wong found that the gender, education level, network access frequency, nutritional knowledge and query technology application capability of the older would significantly affect their network search behaviors of the nutrition and health information [4]. Berné et al. studied the consumer's search behaviors of the product price information in the retailing industry and found that the brand, price, quality guarantee period and sale site of products would affect information search behavior of the consumers [5].

Influence factor setup

The domestic and foreign scholars have achieved rich achievements in research on the consumer's information search behaviors, but the research achievements on Chinese consumer's search behaviors of the food safety information and its influence factors are few. Based on past research of other scholars on the information search behaviors and its influence factors and features of food safety information in China, this study classified and arranged the main factors affecting consumer's search behaviors of food safety information, and summarized 17 possible factors affecting the consumer's seeking food safety information behavior (Table 1).

TABLE 1: Setup of factors affecting consumer's seeking food safety information behavior

Level	Influence factor	Reference
Features of consumer	Gender (C_1), degree (C_2) and monthly home income (C_3) of consumers	[5-7]
Food feature	Food price (C_4), brand (C_5), production place (C_6), appearance (C_7), quality safety certification ((C_8), quarantine mark (C_9), prestige of sale site(C_{10}) and quality guarantee period (C_{11})	[5, 8, 9]
Risk sensing	Consumer's attention to food quality safety (C_{12}) and consumer's risk sensing level to food safety (C_{13})	[10, 11]
Attention to health	Degree of consumer's attention to health (C_{14})	[12-14]
Information search cost	Convenience of consumer's information acquisition (C_{15}) and time pressure sensed by consumer (C_{16})	[3, 15]
Purchase experiences	Purchase frequency of consumer (C_{17})	[16, 17]

Based on the setup of the above factors affecting consumer's seeking food safety information behavior, this paper analyzes attributes and mutual relations of 17 factors, and identifies the critical factors by using the fuzzy set theory and DEMATEL method.

INVESTIGATION DESIGN AND DATA ACQUISITION

Based on the existing research foundation and above research hypothesis, this study designed the questionnaire of the factors affecting consumer's search behaviors of food safety information. Because the foods are diversified, to make responders easily understand food safety information, this study selected the pork as the research object to investigate the consumer's search behaviors of food safety information. The pork was studied because the pork is dominant in the meat consumption of the residents in cities and towns in China. Some severe food safety events such as "Fuxi event", "Huangpujiang dead pig event" and "clenbuterol event" are continuously exposed in recent years, so the pork quality is focused by the whole society. The Ministry of Commerce is also actively driving traceable information system construction for the pork quality safety. So the pork as research object is representative and reasonable.

We invited 10 food safety management experts and researchers for consumer's behavior as the expert group from Jiangsu Food Safety Research Base and Business School of Jiangnan University. These experts were asked to determine the mutual influence degree of 17 factors based on their experiences and knowledge, and we got 10 expert questionnaires on the relation among the factors affecting the consumer's search behaviors of food safety information.

RESEARCH METHOD AND CALCULATION RESULTS

Generally DEMATEL method is used to study mutual influence degree among different factors in a complex system in many research fields and identify the primary and secondary relations of factors in the system according to the mutual influence matrix of the factors [18]. The responders prefer to evaluate the influence degree of the factors by using the linguistic variables instead of precise values, so this paper introduces fuzzy set theory. The evaluation results of the experts based on the linguistic variables are precisely quantified with precise numbers by using triple fuzzy number (TFN), then the CFCS (Converting Fuzzy Data into Crisp Scores) is used to convert the TFN into the precise values [19]. The primary and secondary relations of different factors in the system is identified by using DEMATEL method from the direct relation matrix of the mutual influences of different factors. The specific operation steps are described as follows.

Transform the linguistic variables of expert to TFN

As shown in Table 2, this paper sets the transformation standard value between the linguistic variables and corresponding TFN according to Chen method [20] to transform the language evaluation results of each expert to TFN (l_{ij}^k, m_{ij}^k, r_{ij}^k), k=1, 2, 3, ……, 10, i, j = 1, 2, ……, 17, which indicates the fuzzy assessment given by the Kth expert about the impact of factor i on factor j. The results are recorded into 17×17 matrix.

TABLE 2 : Corresponding relationship between linguistic variables and fuzzy numbers

Linguistic variables	Corresponding TFN
N （No Influence）	（0, 0.1, 0.3）
VL（Very Low Influence）	（0.1, 0.3, 0.5）
L （Low Influence）	（0.3, 0.5, 0.7）
H （High Influence）	（0.5, 0.7, 0.9）
VH（Very High Influence）	（0.7, 0.9, 1.0）

Defuzzification of linguistic evaluation results of experts

The TFN of the expert decision is transformed to the precise values according to CFCS method. The defuzzification process is performed as follows:

Step 1: Standardize TFN. To reduce the bigger subjective difference among experts, the TFN of the evaluation results of experts is standardized according to the equation (1), (2) and (3).

$$xl_{ij}^k = \frac{l_{ij}^k - \min\limits_{1\le k\le K} l_{ij}^k}{\Delta_{min}^{max}} \quad (1)$$

$$xm_{ij}^k = \frac{m_{ij}^k - \min\limits_{1\le k\le K} l_{ij}^k}{\Delta_{min}^{max}} \quad (2)$$

$$xr_{ij}^{k} = \frac{r_{ij}^{k} - \min\limits_{1\le k\le K} l_{ij}^{k}}{\Delta_{min}^{max}} \quad (3)$$

wherein $\Delta_{min}^{max} = \max\limits_{1\le k\le K} r_{ij}^{k} - \min\limits_{1\le k\le K} l_{ij}^{k}$

Step 2: Calculate the left and right standard value. The standardized fuzzy number is transformed to the left and right standard value by using the equation (4) and (5).

$$xls_{ij}^{k} = \frac{xm_{ij}^{k}}{1 + xm_{ij}^{k} - xl_{ij}^{k}} \quad (4)$$

$$xrs_{ij}^{k} = \frac{xr_{ij}^{k}}{1 + xr_{ij}^{k} - xm_{ij}^{k}} \quad (5)$$

Step 3: Calculate total standard value. The left and right standard value is converted to the total standard value by using the equation (6).

$$x_{ij}^{k} = \frac{xls_{ij}^{k}(1 - xls_{ij}^{k}) + xrs_{ij}^{k} xrs_{ij}^{k}}{1 - xls_{ij}^{k} + xrs_{ij}^{k}} \quad (6)$$

Step 4: Quantify the Kth expert's assessment about the influence of factor i on factor j according to the equation (7).

$$a_{ij}^{k} = \min\limits_{1\le k\le K} l_{ij}^{k} + x_{ij}^{k}\Delta_{min}^{max} \quad (7)$$

Step 5: Complete the quantization of fuzzy data by quantifying the group assessments about the influence of factor i on factor j according to the equation (8).

$$a_{ij} = \frac{1}{K}\sum_{k=1}^{k} a_{ij}^{k} \quad (8)$$

Therefore, we can get the final precise value of the mutual influence degree among the evaluation factors of the expert group, record it into 17×17 matrix, and compose the direct influence matrix $A = [a_{ij}]_{17\times17}$, i, j = 1, 2, ……, n, which is required by DEMATEL method in the Table 3. Here A is a non-negative matrix. When i = j, the diagonal element $a_{ij} = 0$.

TABLE 3: Direct influence matrix A of influence factors of consumer's search behaviors of food safety information

	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}	C_{13}	C_{14}	C_{15}	C_{16}	C_{17}
C_1	0.000	0.336	0.400	0.122	0.122	0.122	0.122	0.122	0.122	0.122	0.122	0.664	0.562	0.498	0.630	0.630	0.561
C_2	0.122	0.000	0.753	0.122	0.122	0.122	0.122	0.122	0.122	0.122	0.122	0.633	0.531	0.500	0.753	0.700	0.336
C_3	0.122	0.280	0.000	0.155	0.122	0.122	0.122	0.122	0.122	0.122	0.122	0.500	0.460	0.500	0.469	0.664	0.460
C_4	0.122	0.122	0.122	0.000	0.122	0.122	0.122	0.122	0.122	0.122	0.122	0.122	0.122	0.122	0.122	0.122	0.660
C_5	0.122	0.122	0.122	0.734	0.000	0.122	0.155	0.633	0.122	0.789	0.122	0.368	0.540	0.122	0.122	0.122	0.438
C_6	0.122	0.122	0.122	0.603	0.438	0.000	0.183	0.183	0.122	0.217	0.122	0.277	0.570	0.122	0.122	0.122	0.337
C_7	0.122	0.122	0.122	0.789	0.122	0.122	0.000	0.122	0.122	0.562	0.695	0.630	0.630	0.122	0.122	0.122	0.438
C_8	0.122	0.122	0.122	0.762	0.562	0.122	0.122	0.000	0.122	0.660	0.122	0.789	0.789	0.122	0.122	0.122	0.374
C_9	0.122	0.122	0.122	0.695	0.308	0.122	0.122	0.122	0.000	0.633	0.122	0.817	0.878	0.122	0.122	0.122	0.343
C_{10}	0.122	0.122	0.122	0.498	0.277	0.122	0.122	0.211	0.122	0.000	0.122	0.500	0.562	0.122	0.122	0.122	0.343
C_{11}	0.122	0.122	0.122	0.633	0.122	0.122	0.502	0.122	0.122	0.217	0.000	0.693	0.762	0.122	0.122	0.122	0.368
C_{12}	0.122	0.122	0.122	0.122	0.122	0.122	0.122	0.343	0.122	0.122	0.122	0.000	0.845	0.664	0.122	0.122	0.397
C_{13}	0.122	0.122	0.122	0.122	0.122	0.122	0.122	0.405	0.122	0.122	0.122	0.817	0.000	0.724	0.122	0.122	0.500
C_{14}	0.122	0.122	0.122	0.122	0.122	0.122	0.122	0.122	0.122	0.122	0.122	0.695	0.211	0.000	0.238	0.217	0.337
C_{15}	0.122	0.122	0.122	0.122	0.122	0.122	0.122	0.122	0.122	0.122	0.122	0.397	0.762	0.217	0.000	0.277	0.211
C_{16}	0.122	0.122	0.122	0.122	0.122	0.122	0.122	0.122	0.122	0.122	0.122	0.436	0.570	0.438	0.183	0.000	0.407
C_{17}	0.122	0.122	0.122	0.122	0.122	0.122	0.122	0.122	0.122	0.122	0.122	0.281	0.343	0.122	0.122	0.183	0.000

Calculation of DEMATEL method for mutual relations among factors

This paper applies the software matlab (R2010b) to convert and calculate the matrix via the following steps:

Step 1: Transform the direct influence matrix A to the standardized influence matrix D by using the equation (9).

$$D = \frac{1}{\max\limits_{1\le i\le 17}\sum\limits_{j=1}^{17} a_{ij}} A \quad (9)$$

Step 2: Transform the standardization influence matrix D to the total influence relation matrix T according to the equation (10).

$$T = D(I - D)^{-1} \quad (10)$$

Step 3: Calculate the sum of row r_i and column c_j in the matrix T according to the equation (11) and (12).

$$r_i = \sum_{j=1}^{17} t_{ij} \quad (11)$$

$$c_j = \sum_{i=1}^{17} t_{ij} \quad (12)$$

r_i indicates the sum of direct or indirect influence degree of the factor i on other factors in the system, which is called as influencing degree (D). c_j indicates the sum of direct or indirect influence degree of the factor j on other factors in the system, which is called as influenced degree (R). When the factor $i = j$, $r_i + c_j$ indicates the importance degree of the factor i in the whole system, which is also called as center degree (D+R). $r_i - c_j$ is called as the reason degree (D–R). When $r_i - c_j > 0$, the factor i is called as the reason factor. When $r_i - c_j < 0$, the factor i is called as the result factor.

ANALYSIS BASED ON CALCULATION RESULTS

Attribute analysis of influence factors

Based on the reason degree (D–R) value over zero in the table 4, the reason factors include consumer's gender C_1, degree C_2, monthly home income C_3, product brand C_5, production place C_6, appearance C_7, quality safety certification C_8, quarantine mark C_9 and quality guarantee period C_{11}.

TABLE 4 : Solution of factor D, R, D+R and D–R affecting the consumer's search behaviors of food safety information

	D	R	D+R	D–R
C_1	6.4282	2.4984	8.9266	3.9299
C_2	6.5549	2.8025	9.3574	3.7524
C_3	5.6076	3.2257	8.8333	2.3819
C_4	2.9552	5.9868	8.9420	3.0317
C_5	5.4862	3.5184	9.0046	1.9679
C_6	4.4486	2.4984	6.9470	1.9503
C_7	5.6530	2.8977	8.5507	2.7553
C_8	5.9113	4.1864	10.0977	1.7249
C_9	5.6128	2.4984	8.1111	3.1144
C_{10}	4.2595	4.5989	8.8584	0.3394
C_{11}	5.1221	2.9746	8.0967	2.1475
C_{12}	4.6328	10.4000	15.0327	5.7672
C_{13}	4.8694	10.3998	15.2693	5.5304
C_{14}	4.1768	7.1042	11.2811	2.9274
C_{15}	3.9923	3.9971	7.9894	0.0048
C_{16}	4.1756	4.2886	8.4642	0.1130
C_{17}	3.0006	7.7961	10.7967	4.7956

The consumer's degree C_2, gender C_1 and monthly home income C_3 are ranked 1st, 2nd and 6th position in 17 factors, respectively, while the corresponding influenced degrees are only ranked as 14th, 15th and 11th position. The influence degrees of these three factors are high in the system, but the corresponding influenced degrees are very low. It indicates that degree, gender and monthly home income can significantly affect other factors in the system, but these factors are not easy to be affected by other factors, Therefore, they are very initiative in the system.

The influence degree of quality safety certification C_8 and appearance C_7, quarantine mark C_9 are ranked as 3rd, 4th and 5th position, respectively, but the corresponding influenced degree is only ranked as 8th, 13th and 16th position. It indicates that quality safety certification, appearance and quarantine mark can actively affect other factors, but they are affected by other factors little and are some active in the whole system.

The influence degree of the product brand C_3, quality guarantee period C_{11} and production place C_9 are ranked as 7th, 8th and 11th position, respectively, but the corresponding influenced degree is only ranked as 10th, 12th and 17th position. It indicates that the influence degree and influenced degree of these three factors are low and mutual influence relation of these three factors with other factors in the system is not close.

Based on the reason degree (D–R) value under zero, the result factors include product price C_4, sale site prestige C_{10}, degree of attention to food quality safety C_{12}, food safety risk sensing C_{13}, degree of attention to health C_{14}, information search convenience degree C_{15}, time pressure C_{16} and purchase frequency C_{17}.

The degree of attention to food quality safety C_{12}, food safety risk sensing C_{13}, purchase frequency C_{17} and attention to health C_{12} are ranked as 1st, 2nd, 3rd and 4th position, respectively, but the corresponding influenced degree is ranked as 10th, 9th, 16th and 13th position. It indicates that these factors significantly affect other factors in the system, but their influence degree is lower, so they are strongly passive in essence.

The product price C_4 and sale site prestige C_{10}, are ranked as 5th and 6th position, respectively, and the corresponding influenced degree is only ranked as 17th and 12th. So they are passive to some extent.

The time pressure C_{16} and information search convenience degree C_{15} are ranked 7th and 9th position, respectively, but the corresponding influenced degree is only ranked as 14th and 15th position. The center degree is ranked 13th and 16th position, so their influence degree and influenced degree are lower in the system, which indicates that relation of these two factors with other factors in the system is not close.

Identification of key factors

Based on the identification method of Wu for the key factors [21], this paper recognizes the key factors affecting the consumer's search behavior of food safety information as follows:

First, the consumer's risk sensing C_{13} for the food safety has the maximum center degree 15.2693 in 17 factors, which indicates that this factor has the maximum role in the system, so it is identified as the critical factor. Similarly the center degree of the degree of attention to consumer's food quality safety C_{12}, attention to health C_{14} and purchase frequency C_{17} are ranked as 2nd, 3rd and 4th position, so they are also identified as the critical factors. These factors feature higher influenced degree, but the corresponding influence degree is lower, which indicates that these factors are strongly passive in the system.

Secondly, the center degree of the quality safety certification C_8 is ranked as 5th position and is higher, which indicates that this factor has the bigger role in the system. Its influence degree and influenced degree reach 5.9113 and 4.1864, which are ranked as 3rd and 8th position in 17 factors in the system, which indicates that these factors are closely associated with other factors in the system and are critical.

Thirdly, the center degree of the consumer degree C_2 and product brand C_8 is ranked as 6th and 7th position. The influence degree of two factors is higher and is ranked as 1st position and 7th position. The influenced degree is relatively low in the system and is strongly passive. They have important influencing on other factors in the system, so they can be identified as one of the key factors.

The consumer gender C_1 and monthly home income C_3 are the reason factors and have higher influence degree and lower influenced degree, but their center degree is lower and ranked as 9th and 11th position, so they are not critical factors.

As other food feature variables, although the product's production place C_6, appearance C_7, quarantine mark C_9 and quality guarantee period C_{11} belong to reason factors, their center degree ranked as 17th, 12th, 14th and 15th position is low in the system, and the role in the system is low, so they are not critical factors. The price C_4 and sale site C_{10} are the result factors and have lower influence degree and influenced degree, so they are passive and are not critical in the system.

The time pressure C_{16} and information search convenience degree C_{15} are the result factors. Their center degree is ranked as 13th and 16th position. Their influence degree and influenced degree are also low. Their relation with other factors in the system is not close, so they are not critical.

MAIN CONCLUSIONS AND POLICY MEANING

This paper analyzes the attributes and mutual relation of the factors affecting the consumer's seeking food safety information behavior by using fuzzy set theory and DEMATEL method. It can be concluded as follows:

First, 17 factors affecting the consumer's seeking food safety information behavior are associated with each other and compose a very complex influence system.

Secondly, the influence degree, mode and action mechanism of different factors in the complex system composed of 17 influence factors are different. The consumer's gender, consumer's degree, monthly home income, food brand, production place, appearance, quality safety certification, quarantine mark and quality guarantee are the reason factors and will actively affect other factors in the system. The food price, sale site, consumer's attention to health, degree of attention to food safety, food safety risk sensing, information search convenience degree, time pressure and purchase frequency are the result factors and are affected by other factors much in the system.

Thirdly, the consumer's degree, degree of attention to food safety, food safety risk sensing, purchase frequency, degree of attention to health, quality safety certification and food brand are critical in 17 factors affecting the consumer's seeking food safety information behavior.

Based on the above conclusions, the policy meaning of this paper is described as follows:

First, most consumers have higher risk sensing for the current food safety, so the government should strengthen the food safety supervision, construct the food quality safety guarantee system completely, strictly punish and govern the illegal behavior in the food production, improve overall level of food quality safety, and reduce the risk sensing of the consumers to the food quality safety.

Secondly, for the food producers, the product brand has important influence on the consumer's seeking food safety information behavior, so it is necessary to further strengthen the product quality safety management and brand construction, and promote product quality safety certification, which can effectively reduce food safety risk sensing of consumers and erect better quality safety image in the consumer's heart.

Thirdly, consumers should strengthen quality of the food safety knowledge, gradually establish the scientific and reasonable food safety risk consciousness, and continuously improve their food safety risk prevention level.

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REFERENCES

[1] China Comprehensive Well-Off Research Center; 2011-2012 China foods and drinking safety report Well-Off, 3, 47-52 (2012).
[2] L.H.Wu, X.L.Liu, F.Pu; Journal of Jiangnan University: humanities and social sciences edition, 28, 116-21 (2011).
[3] D.S.Sundaram, R.D.Taylor; Advances in Consumer Research, 25, 440-5 (1998).
[4] E.Manafo, S.Wong; Journal of Nutrition Education and Behavior, 36, 85-9 (2012).
[5] C.Berné, J.M.Múgica, M.Pedraja; Journal of Retailing and Consumer Services, 8, 71-84 (2001).
[6] H.R.Jamali, D.Nicholas; Information Processing & Management, 46, 233-43 (2010).
[7] M.R.Laurent, T.J.Vickers; Journal of the American Medical Informatics Association, 16, 471-9 (2009).
[8] D.Zhu, J.Cai, H.S.Wang; Journal of Public Management, 10, 129-43 (2013).
[9] L.X.Zhang, G.Liu; Agricultural Technology Economy, 32, 97-103 (2010).
[10] P.G.Williams, E.Stirling, N.Keynes; Faculty of Health and Behavioral Sciences, 13, 32-9 (2004).
[11] V.W.Mitchell, G.Harris; European Journal of Marketing, 39, 821-37 (2005).
[12] B.L.Acebrón, J.P.L.Mangin, D.C.Dopico; Journal of International Food &Agribusiness Marketing, 11, 75-96 (2001).
[13] W.Verbeke, L.J.Frewer, J.Scholderer; Analytica Chimica Acta, 586, 2-7 (2007).
[14] C.E.Beaudoin, T.Hong; International Journal of Medical Informatics, 80, 586-95 (2011).
[15] R.X.Liu, L.H.Wu; Lanzhou Academic Journal, 22, 104-10 (2013).
[16] E.Manafo, S.Wong; Journal of Nutrition Education and Behavior, 44, 85-9 (2012).
[17] S.A.Rains, C.D.Karmikel; Computers in Human Behavior, 25, 544-53 (2009).
[18] C.J.Lin, W.W.Wu; Expert Systems with Application, 34, 205-13 (2008).
[19] S.Opricovic, G.H.Tzeng; International Journal of Uncertainty, Fuzziness and Knowledge-based Systems, 11, 635-52 (2003).
[20] C.T.Chen; Fuzzy Sets and Systems, 114, 1-9 (2000).
[21] L.H.Wu, Q.Q.Zhang, L.J.Shan, Z.X.Chen; Food control, 31, 425-32 (2013).