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Original Article

Food suppliers' perceptions and practical implementation of food safety regulations in Taiwan



Wen-Hwa Ko*

Department of Restaurant, Hotel and Institutional Management, Fu-Jen University, New Taipei City, Taiwan

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ABSTRACT

The relationships between the perceptions and practical implementation of food safety regulations by food suppliers in Taiwan were evaluated. A questionnaire survey was used to identify individuals who were full-time employees of the food supply industry with at least 3 months of experience. Dimensions of perceptions of food safety regulations were classified using the constructs of attitude of employees and corporate concern attitude for food safety regulation. The behavior dimension was classified into employee behavior and corporate practice. Food suppliers with training in food safety were significantly better than those without training with respect to the constructs of perception dimension of employee attitude, and the constructs of employee behavior and corporate practice associated with the behavior dimension. Older employees were superior in perception and practice. Employee attitude, employee behavior, and corporate practice were significantly correlated with each other. Satisfaction with governmental management was not significantly related to corporate practice. The corporate implementation of food safety regulations by suppliers was affected by employees' attitudes and behaviors. Furthermore, employees' attitudes and behaviors explain 35.3% of corporate practice. Employee behavior mediates employees' attitudes and corporate practices. The results of this study may serve as a reference for governmental supervision and provide training guidelines for workers in the food supply industry.

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1. Introduction

Over the past few decades, foodborne diseases have posed a global challenge to public health. Food safety is important to

general health, economic development, and social stability, as well as the image of a country and its government [1]. Since 2011, many food safety incidents have occurred and issues have arisen in Taiwan. In 2011, an unethical supplier illegally sold a harmful plasticizer to various companies, which then

* Department of Restaurant, Hotel and Institutional Management, Fu-Jen University, Number 510, Zhongzheng Road, Xinzhuang District, New Taipei City, Taiwan.

E-mail address: 073770@mail.fju.edu.tw.

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used it to manufacture drinks and juices. In 2012, a food supplier added maleic anhydride, which was not allowed in food, to baby formula powder. Most of the sellers of traditional snacks (such as meatballs, pearl tapioca, and oyster omelets) who used the said material owing to a lack of knowledge in the area of food safety, were street vendors. Some of these contaminated snacks, such as pearl tapioca, have been introduced to foreign countries and have affected the food exports and reputation of Taiwan. In an incident in May 2013, many rice factories in Taiwan mislabeled lower-quality imported rice as fine Taiwanese rice, and sold it for an enormous profit. In October 2013, many cooking oil companies were found to have labeled low-quality cooking oil as high-quality oil. Later, businessmen were found to have used unrefined cottonseed oil that may have been contaminated. In September 2014, waste oil, recycled oil, and feed oil were sold as cooking oil. As a result of such cases, people in Taiwan lost confidence in their food suppliers, and some countries prohibited the import of various goods from Taiwan. These food safety problems affected public health and significantly influenced Taiwan's food trading and international reputation.

Taiwan's Legislative Yuan passed the Act Governing Food Safety and Sanitation in May 2013, and enacted new regulations in June 2014. The amendment thoroughly reviewed current laws related to food hygiene and obstacles to their execution. In particular, it regulated risk management in the area of food safety, food import management, the examination of food, and food traceability [2]. The amendment referred to the trace management of materials, which is based on the registration of their importation, the labeling of additives, the labeling of final products, and product risk processing, all of which are critical to the regulations that are enacted by various countries [3]. Food traceability systems can importantly be used to provide information about food safety and quality to consumers [4]. Food traceability is critical in the supply chain of agricultural products and in the management of food logistics [3]. The amendment empowered public health institutions; increased the responsibilities of the food industry, and stipulated fines and punishments for violations of the regulations, establishing a complete system for managing food safety.

When food suppliers respond to new food regulations and consider problems of food safety, consumers have increased confidence in the food that they consume. However, food regulations and corporate policy must be taught to employees through staff training, which improves their knowledge of food safety, as well as related attitudes and behavior [5]. Howes et al [6] showed that, in order to reduce the frequency of occurrence of food poisoning, apart from knowledge and behavior, attitude is crucial. According to Bas et al [7], attitude toward food safety is positively correlated with behavior. In the theory of reasoned action, attitude influences behavior [8,9]. Ko [5] suggested a high correlation between employees' attitudes and work performance. Additionally, according to research on employees of the food industry, the cognition and execution of hygiene and safety procedures of people who have received food safety training exceed those of the untrained [10]. As the range of food suppliers is wide and employees have different backgrounds, this study firstly

determines whether food suppliers' educational training will affect perceptions of, and behaviors related to, food safety.

The media tend to exaggerate food safety problems, causing concern to consumers, who have incomplete or incorrect information. To satisfy these consumers, some food suppliers will adjust their food safety and hygiene practices in response to media reports, without any scientific verification. When health authorities deal with food safety problems, food suppliers may be confused regarding a lack of relevant regulations. In 2014, the government passed new food safety regulations in the areas of product source management and risk management, whose implementation in the industry was expected to improve food safety. Strohbehn et al [11] revealed that many environmental, organizational, and human factors contribute to the success of food safety practices in food service organizations, while a lack of resources (including financial resources, suppliers, and time) has been frequently cited as a barrier to safe food handling. The commitment of management, organizational support, and government policy have been found to affect food safety practices among individual employees and organization [12]. Managers and supervisors can be role models for employees by strictly adhering to food safety regulations, and maintaining clean work sites [13].

For the above reasons, the perception and practical implement of food suppliers in relation to food safety laws and operations affect food safety. By using trained employees as the participants, this study investigates the effect of background variables on such perception and behaviors, the effect of food suppliers' satisfaction with the government's management of food safety, and perceptions of new food safety regulations and current practices.

2. Methods

2.1. Sampling

This study involved purposive sampling, and the recipients of the questionnaire were employees of food suppliers who had worked in that industry for at least 3 months. The food suppliers included companies in the food manufacturing industry, companies in the baking industry, food wholesalers, material suppliers, and packaging material suppliers. A total of 100 pretest questionnaires were distributed, and 98 were retrieved. Following pretesting, 400 formal questionnaires were distributed, and 307 were retrieved, yielding a return rate of 76.8%. Of the corresponding 307 participants, 198 participants (64.5%) had received food safety educational training, and 109 had not (35.5%).

2.2. Questionnaire design

The questionnaire comprised three parts. The first and second parts focused on the perceptions of, and practices related to, food safety regulations, as specified by Ko [9], as well as on the new laws on food safety and sanitation [2]. In-depth interviews were conducted with five food safety experts to establish the questionnaires. Three of these experts were food quality managers and the other two personnel were senior

government supervisors, and all had worked for >15 years in either the food industry or government. The questions covered new regulations, sources of raw ingredients, risk management, and the quality plan for company products.

The pretest data were analyzed using item analysis and factor analysis. Item analysis was performed to evaluate the performance of individual test items, based on the assumption that the overall quality of a test derives from the quality of its items. The item analysis indices of mean, standard deviation, corrected item-total correlation, skewness, and item discrimination were evaluated. No item was deleted. Factor analysis was used as an exploratory method [14]. Exploratory factor analysis (EFA) elucidates the relationships among the observed indicators with regard to their basic factors. Varimax rotation was used to perform the EFA. A minimum eigenvalue of 1.0 was used to extract factors. One item was deleted. The first part of the final questionnaire included 11 questions concerning perceptions of food safety regulations (comprising 6 items related to employees' attitudes and 5 items related to corporate attitudes toward food safety), while the second part included 10 questions concerning the practical implementation of food safety regulations (comprising 3 items related to employee behavior and 7 items related to corporate practices associated with food safety). Items were rated using a 5-point Likert-type scale, from 1 (strongly disagree) to 5 (strongly agree). The third part investigated participants' demographic characteristics, including gender, age, work experience, whether the participant had been trained in food safety, whether the participant had been supervised in food safety, the resources used by the participant to increase knowledge of food safety, and satisfaction with the management of government.

Three experts checked the validity of the final questionnaires. The experts were two food safety professors and one governmental senior supervisor in the area of food safety. For the formal questionnaire, the Cronbach α for perceptions of food safety regulations was 0.93, for employees' attitudes was 0.90, and for perceptions of corporate attitude was 0.92. The Cronbach α for the practical implementation of food safety regulations was 0.88, for employees' behaviors was 0.78, and for corporate practice was 0.90. The Cronbach α values for perceptions and practices revealed acceptable reliability.

2.3. Statistical analysis

All statistical analyses were performed using SPSS for Windows (Version 18.0; SSPS Inc., Chicago, IL, USA). The demographic characteristics and the items related to perceptions and practices associated with food safety regulations were summarized using descriptive statistics. *t*-Testing was performed to detect any relationship between whether participants had received food safety training and their demographic characteristics. Analysis of variance (ANOVA) was performed to compare the demographic characteristics. Pearson's correlation analysis was conducted to analyze relationships among perceptions and practices associated with food safety regulations, and the satisfaction with government. Regression analysis was used to predicate practices from satisfaction with government and perceptions of food safety regulations.

3. Results

Of the 307 participants, 167 were female (54.4%), and 140 were male. Most of the participants were aged 31–40 years (102 people; 33.2%), and most had worked in the food industry for 1–4 years (26.4%), followed by 4–8 years (16.6%). Most of the participants had graduated from a university or college (44%). Most of the represented firms were food manufacturers (60.3%); 65.5% of the participants had received food safety educational training, whereas 34.5% had not. Most of the firms had food safety supervisors. The main sources of knowledge regarding food safety were educational training and media reports. A large majority (73.6%) of the participants were not satisfied with government management. Table 1 presents the demographics of the participants.

3.1. Employees' perceptions and behaviors associated with food safety regulations

From Table 2, the variations among trained employees' perceptions of food safety regulations were determined. Trained employees had more favorable attitudes toward these regulations than did untrained employees. However, corporate concern for food safety did not differ between trained and untrained employees. Therefore, general employees could not evaluate their corporation's true attitude for food safety and were higher than self-attitude scores. Therefore, the following perception dimension was only analyzed by employees' personal attitudes toward practice.

In Table 3, employees who had received food safety training exhibited higher behavior scores in terms of employee behavior or assessment of current corporate execution. The mean of corporate practices in relation to food safety was higher than employee behavior. Trained employees tended to identify with corporate products that met regulations, the establishment of a quality plan by their firm, and the production/sale of products that met food safety requirements.

Based on previous research, trained employees significantly outperformed untrained employees with respect to perceptions and practices associated with food safety. The following analysis was based on 198 trained employees.

3.2. Perceptions and practices associated with food safety regulations, and their relationships with demographic characteristics of employees of food suppliers

Table 4 shows the effect of variables concerning personal background on employees' perceptions of food safety regulations. Personal variables significantly influenced perceptions of food safety regulations. Employees aged 51–60 years had more favorable perceptions than those < 25 years. However, sex, work experience, type of firm, nature of supervision, and sources of knowledge, had no significant effect.

According to research on food suppliers' practices related to food safety (Table 5), employee and corporate dimensions differed significantly. Regarding employee behavior, female employees were superior to male employees. Employees aged 51–60 years exhibited better behavior than others. Those with

Table 1 – Socio-demographic characteristics of the participants (n = 307).

Background variable	Category	No.	Percentage (%)
Sex	Male	140	45.6
	Female	167	54.4
Age (y)	< (and including) 25	32	10.4
	26–30	75	24.4
	31–40	102	33.2
	41–50	67	21.8
	51–60	31	10.1
Time in the food industry (y)	<1	52	16.9
	1–4	81	26.4
	5–8	51	16.6
	9–12	39	12.7
	13–16	26	8.5
	17–20	24	7.8
	>20	34	11.1
Educational level	Senior high school	27	8.8
	Vocational school	52	16.9
	College	62	20.2
	University	135	44.0
Company type	Above graduate school	31	10.1
	Food manufacturing industry	185	60.3
	Baking industry	37	12.1
	Material suppliers	27	8.8
	Food wholesalers	41	13.4
Food safety and hygiene training	Packaging material suppliers	17	5.5
	Yes	198	64.5
Food safety and hygiene manager and supervisor in the company	No	109	35.5
	Yes	281	91.5
Main sources of knowledge related to food safety	No	26	8.5
	Schools	51	16.6
	Media reports	115	37.5
	Educational training	137	44.6
Satisfaction with government supervision and management	Other	4	1.3
	Very dissatisfied	83	27.0
	Dissatisfied	143	46.6
	Neutral	46	15.0
	Satisfied	29	9.4
	Very satisfied	6	2.0

>16 years of work experience performed significantly better than those with <1 year of work experience. The main source of knowledge across all participants was from school and work training. Regarding personal background variables on agreement with corporate execution, employees aged 41–60 years were superior to those younger than 25 years. No other personal variables had an effect on corporate practice.

3.3. Relationship among satisfaction with food safety management by government, perceptions of food safety regulations, and related practices

Results concerning employees' satisfaction with the government's management of food safety had established a significant correlation with employee behavior (Table 6). However, satisfaction with management by government was not significantly correlated with employees' perceptions or corporate practice.

According to the literature, governmental supervision and management affected the effectiveness of corporate food safety practices [13]. Table 7 presents the results hypothesized relationships among these factors. Satisfaction

with government management, employees' attitude, and employees' behavior all predict corporate implementation of food safety regulations. Satisfaction with government management affected only personal behavior, and the effect was weak, with an explanatory power of only 2%. Therefore, the following research studies the effect of employees' attitudes and behaviors on a corporation's implementation of food safety regulations. The independent variable (employee attitude) affects the mediator (employee behavior), and both the independent variable (employee attitude) and the mediator (employee behavior) affect the dependent variable (corporate practice). The last regressed the dependent variable of both the independent variable and the mediator. According to the results, the standardized beta coefficient of employee attitude and corporate practice was lowered from 0.553 to 0.421, which indicated that employee attitude would influence corporate practice through employee behavior. Based on these findings, employee attitudes and behaviors can predict 35.3% of corporate execution of food safety regulations. Furthermore, employee behavior mediates the link between employee attitude and corporate execution behavior.

Table 2 – Mean and standard deviation of perception toward food safety for food suppliers.

Dimensions	Items	Mean	SD	Mean	SD	t value ^c
		N = 198 ^a		N = 109 ^b		
Employee attitudes	I should learn the latest food regulations.	4.22	0.654	3.87	0.872	–3.98***
	I should learn the source of products sold by the company.	4.30	0.643	4.06	0.684	–2.98***
	I pay attention to reports of food hygiene and safety to enhance related professional knowledge.	4.37	0.543	4.16	0.596	–3.172***
	I should pay attention to food safety and be responsible.	4.47	0.602	4.26	0.599	–3.039***
	I should participate in hygiene and safety studies that instruct me to have a positive attitude.	4.26	0.637	3.90	0.838	–4.206***
	I should be actively concerned about food safety regulations.	4.31	0.573	4.05	0.658	–3.709***
Mean		4.32	0.497	4.05	0.579	–4.348***
Corporate concerns for food safety	The company should establish procedures for food safety risk management and control.	4.49	0.559	4.31	0.676	–2.475*
	When customers question the products, the company should provide an immediate explanation.	4.44	0.583	4.38	0.635	–0.952
	The company should actively send products for examination or engage in self-examination.	4.44	0.556	4.42	0.598	–0.329
	Products sold by the company should match the food regulations.	4.56	0.538	4.48	0.571	–1.104
	The company should have a food safety plan.	4.52	0.531	4.47	0.554	–0.735
Mean		4.49	0.478	4.41	0.539	–1.287

SD = standard deviation.
^a The number of employees accepted into food safety and hygiene training.
^b The number of employees that did not accept food safety and hygiene training.
^c Significance: ****p* < 0.005; **p* < 0.05.

Table 3 – Mean and standard deviations of food safety practices for food suppliers.

Dimensions	Items	Mean	SD	Mean	SD	t value ^c
		N = 198 ^a		N = 109 ^b		
Employee behavior	I understand the latest food regulations.	3.47	0.877	2.71	0.926	–7.203***
	I pay attention to reports of food hygiene and safety at all times.	4.05	0.749	3.64	0.776	–4.455***
	I participate in hygiene study regularly.	3.23	0.963	2.33	1.063	–7.690***
Mean		3.58	0.706	2.89	0.767	–8.018***
Corporate practice for food safety	Products sold by the company are based on certificates of raw ingredient sources.	4.34	0.708	4.06	1.008	–2.926**
	When there are problems in a product, I actively report them or suggest the situation to high rank supervisors in the company.	4.04	0.860	3.55	1.118	–4.282***
	Products of the company are based on the procedures of food safety risk management.	4.32	0.681	4.03	0.876	–3.280***
	When customers question the products, the company will send personnel to recognize the situation.	4.42	0.662	4.28	0.826	–1.724
	All products of the company are sent for examination or self-examined.	4.35	0.724	4.28	0.806	–0.769
	All products of the company match the regulations.	4.52	0.619	4.29	0.831	–2.649**
	The company has established a quality plan, and the production or products sold match the requirements of food safety.	4.50	0.594	4.32	0.780	–2.252*
	Mean		4.36	0.535	4.11	0.727

SD = standard deviation.
^a The number of employees accepted into food safety and hygiene training.
^b The number of employees that did not accept food safety and hygiene training.
^c Significance: ****p* < 0.005; ***p* < 0.001; **p* < 0.05.

4. Discussion

This study demonstrates that employees with food safety training exhibited more favorable perceptions and behaviors associated with food safety than did those without. One third of the food suppliers in the sample had not received educational training, and so had lower awareness of food safety regulations, revealing the importance of employee education.

A lack of training tends to result in errors in food handling [15], while effective food safety training can reinforce employees' food safety behavior [16]; enhance their awareness of food safety, and improve their practices related to food safety [17]. Adequate and continuous training clearly promotes the success of food safety programs in different establishments: a recent survey revealed that employees who received mandatory annual food safety training had more relevant knowledge than those without this on-the-job training [18]. As suggested

Table 4 – Perceptions of food safety regulations according to demographic characteristics for food suppliers (N = 198).

Characteristics	N	Employees' attitude		Corporate concern attitude	
		Mean ^{a,b} ± SD	t value/F value ^c	Mean ± SD	t value/F value
Sex					
Female	106	4.38 ± 0.48	3.890	4.51 ± 0.44	0.639
Male	92	4.24 ± 0.96		4.45 ± 0.51	
Age (y)			3.422**		1.387
<25	21	4.09 ± 0.46 ^B		4.29 ± 0.54	
26–30	48	4.23 ± 0.52 ^{AB}		4.49 ± 0.49	
31–40	63	4.36 ± 0.48 ^{AB}		4.49 ± 0.44	
41–50	40	4.30 ± 0.50 ^{AB}		4.48 ± 0.51	
51–60	23	4.57 ± 0.42 ^A		4.62 ± 0.41	
Work experience (y)			1.805		1.743
<1	23	4.14 ± 0.52		4.46 ± 0.50	
1–4	49	4.19 ± 0.53		4.33 ± 0.52	
>4–8	40	4.35 ± 0.47		4.53 ± 0.47	
>8–12	28	4.43 ± 0.46		4.61 ± 0.42	
>12–16	17	4.35 ± 0.43		4.43 ± 0.46	
>16–20 y	14	4.48 ± 0.43		4.67 ± 0.41	
>20 y	27	4.43 ± 0.47		4.53 ± 0.41	
Company type			1.065		1.575
Food manufacturing industry	121	4.30 ± 0.48		4.46 ± 0.45	
Baking industry	29	4.27 ± 0.49		4.47 ± 0.47	
Material suppliers	15	4.28 ± 0.68		4.33 ± 0.64	
Food wholesalers	26	4.50 ± 0.41		4.65 ± 0.42	
Packaging material suppliers	7	4.19 ± 0.55		4.68 ± 0.54	
Company supervisor			1.247		0.056
Yes	187	4.31 ± 0.49		4.48 ± 0.48	
No	11	4.48 ± 0.52		4.45 ± 0.47	
Knowledge source			1.413		0.032
School	39	4.30 ± 0.51		4.49 ± 0.46	
Media	44	4.20 ± 0.47		4.45 ± 0.51	
Training	111	4.36 ± 0.49		4.49 ± 0.48	
Other	4	4.58 ± 0.50		4.50 ± 0.48	

SD = standard deviation.

^a A 5-point Likert scale was used, in which 1 = strongly disagree and 5 = strongly agree.^b Means with a column using different capital letters indicate significant differences.^c Significance: **p < 0.001.

by Moore and Payne [19], food safety education increases awareness of, and motivation to implement, best practices. Le et al [20], who found that participants in training courses were better able to handle food safely, and respondents who had received formal food safety training could successfully identify major biological hazards. Substantive food safety training should be provided for all food service employees to ensure that they implement important practices. The most effective means of adjusting attitudes concerning food safety and, ultimately, the frequency of related practices, is participation in education programs [5].

Most participants regarded attention to food safety as responsible, and most participants indicated that they paid attention to reports of food hygiene and safety. The corporate construct was more important and effective than individual employee constructs to the implementation of food safety regulations. Most firms followed regulations concerning food safety. Research had shown an effective food safety control system can help to maintain the safety of goods that are exported from Taiwan [21]. Therefore, the setting of regulations can support food safety practices, and most firms follow such regulations. Recent food safety regulations have focused on product sources and trace management. Product

traceability systems can be used to ensure the quality and safety of food, confirm its sources, and rapidly solve related problems [4].

According to relevant research, most of the materials in the products had a certificate of origin with an associated quality control plan, which were approved by suppliers and should be maintained. In recent years, many food safety crises have increased public awareness of food safety and caused consumers to feel uncertain about food quality. Many studies have focused on analyzing consumers' perceptions of food traceability systems and traceable foods [22,23]. Food traceability systems can reduce the anxiety of consumers regarding food safety by providing a form of quality assurance; they have been introduced by governments and food producers to increase consumer confidence [24]. Corporate attitude is the factor that dominates product traceability [25], while corporate managerial support is the factor that dominates employees' food safety practices [26]. Many countries have legally required the establishment of traceability systems, including the USA [27], China [28,29], and Korea [30].

The participants' personal background variables revealed that females behaved better with respect to food safety, and employees aged 51–60 years had better attitudes and

Table 5 – Practices of food safety regulations according to demographic characteristics for food suppliers (N = 198).

Characteristics	N	Employee behavior		Corporate practice	
		Mean ^{a,b} ± SD	t/F ^c	Mean ± SD	t/F
Sex					2.207
Female	106	3.74 ± 0.64 ^A	11.265***	4.40 ± 0.50	
Male	92	3.41 ± 0.73 ^B		4.29 ± 0.56	
Age			3.198*		5.572***
<25	21	3.42 ± 0.80 ^{AB}	3.361**	4.02 ± 0.57 ^B	2.443
26–30	48	3.41 ± 0.72 ^B		4.22 ± 0.65 ^{AB}	
31–40	63	3.56 ± 0.66 ^{AB}		4.38 ± 0.45 ^{AB}	
41–50	40	3.67 ± 0.75 ^{AB}		4.45 ± 0.48 ^A	
51–60	23	3.97 ± 0.49 ^A		4.65 ± 0.32 ^A	
Work experience (y)					
<1	23	3.20 ± 0.78 ^B	0.942	4.16 ± 0.73 ^B	1.418
1–4	49	3.48 ± 0.69 ^{AB}		4.21 ± 0.56 ^B	
>4–8	40	3.60 ± 0.65 ^{AB}		4.34 ± 0.48 ^{AB}	
>8–12	28	3.54 ± 0.77 ^{AB}		4.45 ± 0.47 ^{AB}	
>12–16	17	3.74 ± 0.64 ^{AB}		4.40 ± 0.43 ^{AB}	
>16–20	14	4.14 ± 0.72 ^A		4.58 ± 0.45 ^{AB}	
>20	27	3.74 ± 0.45 ^{AB}		4.56 ± 0.41 ^A	
Company type					
Food manufacturing industry	121	3.59 ± 0.69	0.004	4.31 ± 0.52	0.616
Baking industry	29	3.71 ± 0.67		4.43 ± 0.47	
Material suppliers	15	3.57 ± 0.56		4.32 ± 0.56	
Food wholesalers	26	3.55 ± 0.80		4.54 ± 0.55	
Packaging material suppliers	7	3.14 ± 0.87		4.16 ± 0.73	
Company supervisor					
Yes	187	3.59 ± 0.71	3.761*	4.34 ± 0.54	2.249
No	11	3.57 ± 0.63		4.48 ± 0.44	
Knowledge source					
School	39	3.55 ± 0.79 ^{AB}	3.761*	4.19 ± 0.71	2.249
Media	44	3.30 ± 0.61 ^B		4.29 ± 0.49	
Training	111	3.70 ± 0.69 ^{AB}		4.43 ± 0.47	
Other	4	3.83 ± 0.58 ^A		4.29 ± 0.37	

SD = standard deviation.

^a A 5-point Likert scale was used, in which 1 = strongly disagree and 5 = strongly agree.^b Means with a column using different capital letters indicate significant differences.^c Significance: ****p* < 0.005; ***p* < 0.001; **p* < 0.05.**Table 6 – Relationship among government management satisfaction, food safety regulation perception, and practice for food suppliers.**

	Government management satisfaction	Employee attitude	Employee behavior	Corporate practice
Government management satisfaction	1			
Employee attitude	0.096	1		
Employee behavior	0.158*	0.553**	1	
Corporate practice	0.088	0.495**	0.475**	1

Significance: ***p* < 0.001; **p* < 0.05.

behaviors regarding food safety regulations than employees of other ages. Participants with >16 years of work experience behaved better than others. The results were consistent with previous research that has found that the attitudes and behaviors of female university students who have participated in food safety courses were significantly better than those of other female university students [31]. Age was found significantly to affect employee behavior; the food safety practices of people aged 51–60 years were superior to those of employees aged <25 or 26–30 years. This result was consistent with the

findings of Altekruze et al [32], who found that increased age was associated with more effective behaviors related to food safety. According to Brannon et al [33], employees' experiences of the food service industry help them recognize issues associated with food safety practices. Employees' perceptions of the food safety cultures of other food service companies vary with demographic variables and the operating characteristics (such as management system, size, and type of operation). Employees' perceptions of food safety culture were evaluated on factors of management and coworkers support,

Table 7 – Regression analysis of government management satisfaction, food safety perceptions, and practices for food suppliers.

Dependent variable—Independent variable	Adjusted R ²	Standardized beta coefficient	t value	Significance
Employee behavior	0.020			
– Management satisfaction		0.158	0.244	0.026
Employee behavior	0.286			
– Employee attitude		0.537	11.115	0.000
Corporate practice	0.221			
– Employee behavior		0.475	7.551	0.000
Corporate practice	0.302			
– Employee attitude		0.553	9.294	0.000
Corporate practice	0.353			
– Employee attitude		0.421	6.364	0.000
– Employee behavior		0.266	4.031	0.000

communication, self-commitment, environment support, work pressure, and risk judgment [34]. However, this study did not find any variations in perceptions of food safety culture among the various food industries.

Employees' perceptions and behaviors associated with food safety regulation were not significantly correlated with their satisfaction with management by the government. However, when employees had more positive attitudes toward food safety regulations, their behaviors would be more effective. Therefore, greater satisfaction with government and corporate practice management was associated with greater effectiveness in implementing food safety regulations. The most important goal of the training is not only the employee's gaining of knowledge, but also the changing of habitual behaviors [35]. To be effective, an educational program must be based on an understanding of the causes of the adoption of certain attitudes, and then change them as required [36]. By legal mandate, effective hygiene training (or supervision) within the food service industry is a priority of any food safety management strategy, as training improves food safety because acquired knowledge leads to favorable changes in behavior in the work place [5]. Positive attitudes and behaviors can effectively guarantee employees' compliance with food safety regulations [6]. However, knowledge does not directly affect behavior; rather it influences behavior indirectly through attitude [37]. Hedberg et al [38] found that employees' food safety practices are the main contributors to foodborne illness. Positive attitudes and behaviors can effectively ensure employees' implementation of food safety regulations. Trainers can reinforce food safety practices by instilling a positive attitude [39]. The implementation and continuous application of a food safety management system in small and medium-sized food firms are very difficult, owing to a lack of knowledge of their employees regarding food safety, a lack of financial resources (particularly investments in structure, equipment, and staff), a lack of time to establish and run a food safety program (like HACCP). Therefore, many firms have claimed that food safety control systems must overcome various obstacles. Changing attitudes changes behavior [40,41]. The commitment of management commitment, organizational priority and support, and a communication policy, are some of the organizational factors that have been found to influence the food safety practices of individual employees and organizations [12]. However, this investigation yields contradictory results perhaps because most food

suppliers are not currently satisfied with the management of food safety by governments.

5. Conclusion

Perceptions of food safety regulations were classified into the constructs of employees and corporate attitudes. Practices were classified into employee behaviors and corporate practices. This study found that employees with food safety training were significantly superior in their perceptions and behaviors associated with food safety regulation. Most of the participants in this study regarded attention to food safety as responsible, and most suggested that they paid attention to reports of food hygiene and safety at all times. Females, older employees, and employees with more work experience were superior in employees' perception and practice. Satisfaction with management by management was not significantly related to corporate practice. Employees' attitudes and behaviors affected the corporate practices of suppliers to meet food safety regulations. Employee behavior also mediated the link between employees' attitudes and corporate practices.

This investigation found that the attitudes of employees who participated in food safety and hygiene training were significantly superior to those of employees who had never received such training. Therefore, this study suggests that employees in food supply firms should be given regular hygiene training to support positive attitudes toward food hygiene, as doing so will improve the effectiveness of practices related to food safety and hygiene. Employees can participate in hygiene-related training programs, offered by the government, to improve their attitudes toward, and practices related to, food safety and hygiene. Currently, employees in the food industry gain knowledge about food safety through educational training, which is critical to the successful communication of such knowledge. Today, Taiwan's government only provides 8 hours of educational training annually for certified cooks. Training covers food regulations, e.g., food labeling, food traceability, cleaning management, procurement, and checking. This study suggests that large firms can host hygiene training. Small firms can participate in hygiene training that is provided by local health divisions to provide employees with knowledge about food safety. Additionally, employees' personal study is important. When employees develop good habits related to food safety, they will change how they

implement and corporate food safety regulations. This study suggests that the industry should prioritize the recruitment of employees who actively engage in training. In this study, 37.5% of the participants stated that the media were their main source of knowledge about food safety. Recent research into food safety suggests that the Internet and social media are being used to reach target groups of younger consumers [42,43], which finding is worrisome because the information thus provided is often incorrect; although consumers gain knowledge in this area from the media, employees in the food industry should realize that government and corporate educational training are the main sources of knowledge about food safety regulations, and they should not treat the media as the major source of knowledge, as the information provided may be misleading.

In this study, 73.6% of the participants were not satisfied with the government's supervision of food safety, possibly owing to the high frequency of food safety-related incidents in recent years. This study recommends that governments more actively and effectively meet their duties of investigation issues related to food safety and providing relevant supervision by increasing the frequency of spot checks in the food industry, or by asking for active management and regular reports to improve the public's satisfaction with the government's supervision of food safety. Governmental agencies could host lectures on food hygiene and safety, and reinforce positive concepts in the media, to focus public attention on food safety. A reliable system for encouraging industry to engage in excellent practices by reporting prominent companies could be established, and these practices could be used as references for decision making.

This study had some limitations. The companies were of different sizes and had different numbers of employees, so the samples were not balanced. One third of the employees who participated in this study had not received relevant training. As participants were required to understand food safety regulations and their corporate implementation, the analysis involved only trained employees. This study involved self-reports, which may have been biased. Researchers in the future will be able to probe and focus on different food-related industries. This study focused on the attitudes and food safety practices of food suppliers. Future studies should consider factors that affect knowledge of both food safety and hygiene.

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