



Effects of HACCP System Implementation on Domestic Livestock Product Plants

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Abstract

The objective of this study was to investigate the problems and benefits associated with the implementation of HACCP on livestock product of plants in Korea. The survey was carried out by randomly selecting 115 HACCP accredited meat processing plants, all across the country. A total of 105 complete responses were selected for analysis. The results were as follows: approximately 60% of the respondents employed less than twenty workers. The average period of operating HACCP system was 3.4 years. The respondents replied that the major incentive to implement the HACCP system was to improve hygiene management ability. More than half of the respondents (59.05%) claimed that the implementation of the HACCP system cost less than 400 million won, and the highest investment in terms of cost was the freezer/refrigerator. In the preparation period taken to implement the HACCP system, the 6-12 mon category had the highest percentage (55.24%). Most respondents replied that there was an increase in the customer satisfaction, plant image and turnover, after HACCP implementation ($p < 0.05$). A total of 98.09% of respondents had the opinion that their plant workers had improved in their understanding of food hygiene by HACCP implementation ($p < 0.05$). Approximately 79% of respondents indicated that customer complaints decreased, as a result of HACCP implementation.

Key words: HACCP, implementation, livestock product plants, survey

Introduction

Hazard Analysis Critical Control Point (HACCP) is a management system to control biological, chemical, and physical risks that may result from growing, harvesting, processing, manufacturing, transporting and distributing, or preparation and consumption of manufactured food. The goal of implementing HACCP is to manage potential hazards through risk assessment during food production with a focus on prevention rather than end product testing (Kwak, 1999; Unnevehr and Jenson, 1996). The HACCP becomes one of the best tools for preventing and reducing biological, physical and chemical hazards from food or foodstuffs to acceptable levels (Lee *et al.*, 2010, Lee *et al.*, 2011; Nam *et al.*, 2008).

In Korea, the hygiene and safety of livestock products has become a major issue of concern. In several countries, including Korea, HACCP system has been introduced with regard to product hygiene and safety.

The HACCP system including Sanitary Standard Operation Procedure (SSOP), and Good Manufacturing Practice (GMP) was established to comply with the Livestock Products Processing Act (LPPA) in 1997 (Lee, 2007). It was first introduced to slaughterhouses and livestock product plants. After that the system was extended, according to the plan of Ministry for Food, Agriculture, Forestry and Fisheries (MIFAFF) in Korea, to raw milk collection, the keeping and transportation of livestock products, meat retailers and animal farms by yearly plan. In 2006, Korea Livestock Products HACCP Accreditation Service (KOLPHAS) was established to activate HACCP system implementation in livestock industry. The roles of KOLPHAS are designation and control of HACCP from the farm to the consumption stage, namely farm, feed factory, milk depot, processing, transport, keeping, and retailer.

Total number of livestock product plants in 2009 is approximately 2,757 plants in Korea. In the area of livestock product plants, most developed countries including USA (1998), EU (1996) and Australia (1997) are implementing HACCP system as an obligation. In Korea, HACCP implementation of the slaughter house is only

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compulsory. The HACCP system was implemented on meat processing plant in 1997, slaughter house in 2000, livestock product plant in 2001, milk processing plant, meat sale and distribution in 2004, feed mill in 2005, and animal farm in 2006 (Animal, Plant and Fisheries Quarantine and Inspection Agency, 2010)

The studies on HACCP have recently focused on evaluation of sanitation management performance, benefits of HACCP implementation, and employees' knowledge and performance degree of HACCP in school foodservice sector (Kim and Lee, 2008; Moon and Ryu, 2004; Park and Park, 2009).

In the livestock products sector, economic feasibility of HACCP at slaughter house (Kwak *et al.*, 2002), productivity analysis of HACCP implemented pig farms (Nam *et al.*, 2008), and comparative analysis of the prerequisite items for HACCP in livestock product plants (Hong and Cho, 2008) have been reported. However, there have not yet been studied about the basic information for implementation and advantages of HACCP in the livestock products sector.

Therefore, the aims of this study were to determine factors affecting HACCP implementation, and to investigate the effect of HACCP implementation on domestic livestock product plants.

Material and methods

Survey

In this study, a survey was conducted with subjects to operate HACCP in livestock product plants during the period July 1 to December 5, 2008. A self-administered questionnaire was distributed in person by the researchers. The survey was carried out at 115 livestock product plants located in all around of Korea (Table 1). Most of the respondents were heads of quality control departments, and all of respondents claimed that they operated HACCP system in plants.

Questionnaire

The survey questionnaire was prepared and modified according to the results of related studies (Bai *et al.*, 2007; George and George, 1999; Spencer *et al.*, 1999). The questionnaire sought information about the general characteristics of the subjects and effect of the HACCP system implementation. A total of 115 questionnaires were distributed, and 105 respondents completed the survey with an overall response rate of 91.34%. The survey instrument consisted of 3 parts. In part 1 (4 of 16 questions),

Table 1. Location of respondents participated in the survey of livestock product plants that implemented HACCP system

Location	N ¹⁾	%
Seoul	7	6.09
Gyeonggi	21	18.26
Kangwon	9	7.82
Gyeongbuk	15	13.05
Gyeongnam	18	15.65
Chungbuk	7	6.09
Chungnam	11	9.56
Jeonbuk	11	9.56
Jeonnam	9	7.83
Jeju	7	6.09

¹⁾N=115

we asked the general characteristics of subjects' plant, such as period of HACCP operating, number of employees, annual turnover, and whether other accreditations had been adopted (Table 2). Part 2 contained 6 questions related to factors that may affect HACCP implementation (Table 3-Table 7). In part 3, 105 respondents were divided into four groups according to the number of employees as shown in Table 2. This part consisted of 6 questions related to benefits and effects of HACCP implementation (Table 8-Table 13).

Statistical analysis

The questionnaire responses were analyzed using SPSS 12.0 for Windows (Version 12.0 software, 2004, SPSS, Inc., Chicago, IL). To examine the relationship among the variables, the chi-square test was used, and the level of statistical significance was $p < 0.05$.

Results and Discussion

General characteristics

Table 2 shows the general information of each subdivided livestock product plants. The average years of operating HACCP system was 3.4 years. The highest was 3-4 years (34.29%), whereas less than 1 year was the lowest (8.57%). Approximately 60% of the respondents employed less than twenty workers and/or had a turnover of less than 7 billion won. We also asked respondents whether they had implemented any other accreditation. A total of 25 (23.81%) among the 105 respondents claimed that they had other quality management systems such as Korea Food & Drug Administration (KFDA) HACCP, Good Manufacturing Practice (GMP), International Standardization Organization (ISO) series, and domestic quality

Table 2. General information respondents participated in the survey for HACCP system implemented livestock product plants

General characteristics of respondents ¹⁾		N	%
Total operation period of HACCP	1 years	9	8.57
	2 years	33	31.43
	3-4 years	36	34.29
	5-7 years	27	25.71
	Total	105	100
Number of employees	less than 10	35	33.33
	10 to 20	31	29.52
	21 to 50	25	23.81
	more than 50	14	13.33
	Total	105	100
Annual turnover (billion won)	less than 3	35	33.33
	3 to 7	26	24.76
	7 to 12	20	19.05
	more than 12	24	22.86
	Total	105	100
Other accreditations implemented	KFDA ²⁾ -HACCP ³⁾	4	3.81
	ISO ⁴⁾ series	13	12.38
	Domestic quality certification system	8	7.62
	Not implemented	80	76.19
	Total	105	100

¹⁾Period of survey: July 1, 2008 to December 5, 2008

²⁾KFDA: Korean Food and Drug Administration

³⁾HACCP: Hazard Analysis and Critical Control Point

⁴⁾ISO: International Standardization Organization

certification systems (e. g. G-mark certification).

HACCP system implementation

Table 3 shows the reasons for the implementation of the HACCP system. The main incentive of respondents was to improve hygiene management ability (34.74%), followed by the improvement of customer confidence (24.88%), recommendation by trade organization (15.49%), and the increase of product sales (15.49%). Respondents attributed much more importance to improved hygiene management ability rather than the increase in turnover. In contrast, a comparable study by Anastasios and Achilleas (2007) evaluated the incentives of HACCP implementation of food enterprises and reported that the major incentive among respondents was to provide them with more chances to improve production procedures rather than to improve product quality. In other words, they were implemented HACCP system as a way of improving their profit. Madonado *et al.* (2005) and Henson *et al.* (1999) reported that the major benefit of implementing HACCP in the Mexican meat industry and the UK milk processing

Table 3. Purpose of implementing HACCP system to the respondent's livestock product plants

Incentives	N	%
To recommend trade organization	33	15.49
To improve hygiene management ability	74	34.74
To improve customer confidence (satisfaction)	53	24.88
To increase product sales	33	15.49
To reduce customer complaints, Reduces the number of claims	17	7.98
Unknown	3	1.41

A respondent (n=105) have indicated more than one type.

industry were to reduce product wastage. Compared to other countries, our results suggest that Korean livestock product plants were more likely to implement HACCP to improve hygiene ability rather than for other reasons. This result might be related with some reasons. First, Korean consumers showed increased the knowledge about food hygiene result from bovine spongiform encephalopathy (BSE), foot and mouth disease (FMD), and Bird Influenza etc. Second, food hygiene might be the most important factors for livestock product plants employers and employees because SSOP was compulsorily applied for livestock products processing plant.

As for the cost of HACCP implementation, two hundred million won to less than four hundred million won was the highest (25.71%) and less than one hundred million won was the lowest at 15.24%. More than half of respondents (53.33%) spent one million won to less than ten million won for annual HACCP operating cost, and the average cost was three hundred fourteen million won in all respondents (Table 4). As a result, we found that total

Table 4. HACCP set-up or annual HACCP operating cost (Property, plant, and equipment expenditures) required to comply with HACCP

	Million won	N	%
HACCP implementation cost	less than 100	16	15.24
	100 to 200	19	18.10
	200 to 400	27	25.71
	400 to 800	17	16.19
	800 to 3,000	17	16.19
	Unknown	9	8.57
	Total	105	100
Annual HACCP operation cost	less than 1	2	1.90
	1 to 5	25	23.81
	5 to 10	29	27.62
	10 to 30	31	29.52
	30 to 50	7	6.67
	more than 50	11	10.48
	Total	105	100

livestock product industry investment amounted to about 380 million in HACCP-required investments.

As the individual costs of operating HACCP in their plant (Table 5), 68.57% of respondents presented freezer/refrigerator to be the highest invest cost associated with the implementation of HACCP. However, other respondents indicated sanitation equipment (8.57%), floor and ceiling (8.57%), or Heating, Ventilation, and Air Conditioning (HVAC) system (6.67%).

The majority of the respondents (89.44%) claimed that they had used an external consultant to develop their HACCP system (data not shown). This result was consistent with the study by Anastasios and Achilleas. (2007). They reported that 74 of 83 companies (89.2%) which have a quality assurance system, such as HACCP and/or

Table 5. Rank of cost for equipment and facilities of HACCP implemented livestock product plants

Contents	N	%
Freezer/refrigerator	72	68.57
HVAC system ¹⁾	7	6.67
Sanitation equipment	9	8.57
Measure utensil	4	3.81
Floor, ceiling	9	8.57
Expert employment	3	2.86
Wall	1	0.95
Total	105	100

¹⁾An HVAC (Heating, Ventilation, and Air Conditioning) system is designed to control temperature, humidity, purity, and distribution of conditioned air throughout a plant.

Table 6. Main point used external consultant in the HACCP system implementation ¹⁾

Contents	N	%
Plant schematic	23	11.06
Facility construction	27	12.98
Standard guideline	62	29.81
Manager training	39	18.75
Record keeping	28	13.46
Affairs administration	8	3.85
Above all	21	10.10

¹⁾n=94 respondents who said they had used external consultant
A respondent have indicated more than one type.

Table 8. HACCP system implementation was contributed to develop our plant

Number of employees	Yes (%)	A little (%)	No (%)	Total (n)	χ^2	df	p
< 10	30 (85.71)	4 (11.43)	1 (2.86)	35	4.185	6	0.652
10 to 20	23 (74.19)	8 (25.81)	0 (0)	31			
21 to 50	19 (79.17)	4 (16.67)	1 (4.17)	24			
> 50	13 (86.67)	2 (13.33)	0 (0)	15			
Total	85 (80.95)	18 (17.14)	2 (1.91)	105			

ISO series, used an external consultant to develop their HACCP system. This result reflects how important the role of the external consultants in the HACCP implementation is. Table 6 presents a list of 7 types of consultancy services and we asked respondents to rank these according to their importance in HACCP implementation in their plant (A respondent was permitted to indicate more than one type).The respondents claimed that the most important contents during the development of the HACCP system was to make standard guideline (29.81%), and the second most important contents was to manager training (18.75%).

In the period taken to implement the HACCP system, the category 6-12 mon had the highest percentage (approximately 64%) among the respondents, while the lowest period category was less than 6 mon (9%).

Effects of HACCP system implementation

In part 3, we asked respondents 6 questions related to the effect of HACCP implementation (Table 8-11). The respondents were divided into four groups by the number of employees, and a chi-square test was employed to compare the characteristics of the four groups. Table 7 shows the effect of adopting HACCP for the livestock product plants. 80.95% of the respondents replied that the plants themselves were developed throughout operating the HACCP system, with only 1.91% claiming no effect. Although there was no significant difference in the effect of HACCP adoption, plants of less than 10 employees was highest, and over 50 employees was lowest. Table 9 found that 91.43% of all respondents claimed that there was an increase in customer satisfaction after HACCP

Table 7. Preparatory periods for implementing HACCP system

Periods	N	%
Less than 6 mon	9	8.57
6-12 mon	58	55.24
12-24 mon	28	26.67
More than 24 mon	10	9.52
Total	105	100

implementation, whereas only 8.57% of respondents claimed that implementation of HACCP had no relation to customer satisfaction in their plants. Chi-square test showed that the fewer number of employees significantly affected to the HACCP system adoption ($p < 0.05$). The proportion indicating "increase" was 73.33% and for "a little increase" 18.10% of all respondents. In this respect, the survey result identified that 81.90% respondents (16.19% strongly agreed and 44.76% completely agreed) believed that sales was increased by HACCP implementation (Table 12). It was found that 98.09% of all respondents had the opinion that their plant workers had an improvement in their understanding of food hygiene by implementation of HACCP in Table 10 ($p < 0.05$). This finding was consistent with result of Table 3. In other words, the most important purpose of HACCP implementation for survey respondents was to improve hygiene

management ability. Interestingly, the relative large size livestock product plants (>21 employees) respondents who claimed implementation of HACCP had not related to customer satisfaction and knowledge of hygiene of employees was significantly higher than those of the relative small size ones (<20 employees) ($p < 0.05$). Indeed, most of the relatively large sized livestock product plants were operating other food safety/quality management systems, such as GMP/SSOP, ISO series, and domestic quality certification system (data not shown). Thus, this result means that customer satisfaction and knowledge of hygiene of employees had already been improved by food safety/quality management systems. When respondents were asked whether their plant image was improved by HACCP implementation (Table 11), 94.29% agreed. Table 12 found that 81.90% of the all respondents claimed that their plant had increased turnover as a result of imple-

Table 9. Changes of customer satisfaction after implementing HACCP system

Number of employees	Yes (%)	A little (%)	No (%)	Total (n)	χ^2	df	<i>p</i>
< 10	28 (80.00)	7 (20.00)	0 (0)	35	17.803	6	0.007
10 to 20	26 (83.87)	5 (16.13)	0 (0)	31			
21 to 50	14 (58.33)	5 (20.83)	5 (4.76)	24			
> 50	9 (60.00)	2 (13.33)	4 (3.81)	15			
Total	77 (73.33)	19 (18.10)	9 (8.57)	105			

Table 10. Changes of improvement of understanding hygiene and food safety after implementing HACCP system

Number of employees	Yes (%)	A little (%)	No (%)	Total (n)	χ^2	df	<i>p</i>
< 10	33 (94.29)	2 (5.71)	0 (0)	35	12.697	6	0.048
10 to 20	30 (96.77)	1 (3.23)	0 (0)	31			
21 to 50	23 (95.83)	1 (4.17)	0 (0)	24			
> 50	12 (80.00)	1 (6.67)	2 (13.33)	15			
Total	98 (93.33)	5 (4.76)	2 (1.91)	105			

Table 11. Image changes after HACCP system implementation

Number of employees	Yes (%)	A little (%)	No (%)	Total (n)	χ^2	df	<i>p</i>
< 10	20 (57.14)	13 (37.14)	2 (5.72)	35	4.595	6	0.597
10 to 20	22 (70.97)	7 (22.58)	2 (6.45)	31			
21 to 50	18 (75.00)	4 (16.67)	2 (8.33)	24			
> 50	11 (73.33)	4 (26.67)	0 (0)	15			
Total	71 (67.62)	28 (26.67)	6 (5.71)	105			

Table 12. Changes of turnover after HACCP system implementation

Number of employees	Increase	A little	No relation	A little	Decrease	Total (n)	χ^2	df	<i>p</i>
< 10	5 (14.29)	26 (74.29)	2 (5.71)	1 (2.86)	1 (2.86)	35	25.147	12	0.014
10 to 20	16 (51.61)	10 (32.26)	2 (6.45)	3 (9.67)	0 (0)	31			
21 to 50	12 (50.00)	7 (29.17)	3 (12.51)	2 (8.33)	0 (0)	24			
> 50	6 (40.00)	4 (26.67)	3 (20.00)	1 (6.67)	1 (6.67)	15			
Total	39 (37.14)	47 (44.76)	10 (9.53)	7 (6.67)	2 (1.90)	105			

Table 13. The rate of customer complaint after HACCP system implementation

Number of employees	Increase	A little	No relation	A little	Decrease	Total (n)	χ^2	df	p
< 10	1 (2.86)	1 (2.86)	2 (5.71)	13 (37.14)	18 (51.43)	35	11.006	12	0.528
10 to 20	0 (0)	2 (6.45)	6 (19.35)	12 (38.72)	11 (35.48)	31			
21 to 50	1 (4.17)	3 (12.50)	2 (8.33)	8 (33.33)	10 (41.67)	24			
> 50	0 (0)	0 (0)	4 (26.67)	5 (33.33)	6 (40.00)	15			
Total	2 (1.91)	6 (5.71)	14 (13.33)	38 (36.19)	45 (42.86)	105			

menting HACCP, especially those plants with less than 10 employees, which was the highest in each group, 36.05% (31 of 86 respondents claimed an “increase” or “a little increase”) ($p < 0.05$). Respondents were asked that whether HACCP implementation increased or decreased customer complaints at their plants (Table 13) and 79.05% indicated a decrease resulting from HACCP implementation.

In conclusion, implementation of HACCP system on livestock product plants can be used to increase livestock product safety by understanding food hygiene of plant workers and increasing the rate of sale. Further study was required to investigate the rate of biological contamination, e.g. with *Escherichia coli* and *Salmonella* spp., before and after HACCP system implementation on livestock product plants in the future.

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