

Cost–benefit analysis of HACCP implementation in the Mexican meat industry

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Abstract

This paper reports the levels of HACCP implementation, costs of implementation and operation, and benefits of implementation for the Mexican meat industry. One hundred and sixty Federal Inspection Type (TIF) enterprises were surveyed, with a 58% response rate. Only 18% of the TIF enterprises interviewed had totally adopted HACCP, while 20% did not have an interest in adoption. The norm of ISO 9000 appeared to be an intermediate step in HACCP implementation. The results show that investment in new equipment and microbiological tests of products accounted for most of the implementation and operational costs, respectively. The main benefit reported was reduction in microbial counts, while staff training was reported as a significant problem. The study shows that although the level of total HACCP implementation is not high, HACCP has implications for both the domestic and international markets.

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1. Introduction

In response to the increasing awareness of foodborne illness, consumers are showing more interest in food quality and safety than they did a few years ago (Henson & Caswell, 1999). Likewise, the outbreaks of animal diseases in Europe have made evident the urgent need for meat products to comply with stricter food safety controls. Regulatory measures imposed on the food industry have multiplied and international markets are requiring increasingly rigorous systems. The *Hazard Analysis Critical Control Point* (HACCP) system has been developed to obtain better food safety (Mortimore

& Wallace, 1998). ISO 9000 is a self-regulation standard within food industry to assure food quality (Henson & Caswell, 2001). However, in Mexico there is little published information on the status of adoption of these systems by the meat industry or the benefits and costs that come with them.

Outcomes from HACCP implementation vary widely among food companies throughout the world (Aburto, 1998). Generally, HACCP implementation requires a complex interrelation among governments, industry and consumers (Salay & Caswell, 1998). The government has the responsibility, through its food agencies, to promote laws and regulations that address food safety concerns. Unfortunately, this responsibility is not always accomplished. On the other hand, consumers in some countries argue that international standards offer a lower level of protection than domestic standards (Bureau & Jones, 2000).

In Mexico, the Ministry of Agriculture, Livestock, Rural Development, Fisheries and Food (SAGARPA) has direct control of food quality on meat processing in

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the 160 Federal Inspection Type (TIF) meat processing plants. These plants incorporate new control points for materials used to handle residues and detect possible causes of ecological contamination (DGG-CEA, 2000). Additionally, the National Food Safety and Quality Program (Programa Nacional para la Inocuidad y Calidad Alimentaria—PRONINCA) has been incorporated to promote the implementation of HACCP in the processing and handling of fresh vegetables and meats processing and handling (SAGARPA, 2000). Unfortunately, there are county slaughterhouses that supply meat to local markets that have no direct supervision by SAGARPA.

The TIF industries are under Mexican norms (Norma Oficial Mexicana—NOM), in which there is no mandatory implementation of HACCP systems to get access to domestic market and consumers are not well-informed. Nevertheless, these systems have become indispensable requirements for exporting companies and enterprises that have not implemented them will face loss of customers and markets (Maldonado & Sagar-naga, 2000). Thus, it is useful to evaluate the present situation of the food industry in Mexico and analyze its implications for domestic and international trade.

Enterprises explain their interest in HACCP implementation as a mean to reach international markets, but they also found that HACCP contributes to process improvement and its competitiveness, in addition to reduction in transaction costs. That meant that their primary motives in the adoption of HACCP were focused on product differentiation and in increasing differentiated markets as well (Zinggers, 1999). In contrast, there were industry segments related to food market that pointed out that they did not have motives or gains from the implementation of food safety systems as the HACCP (Martin & Anderson, 1999).

Martin and Anderson (1999) found that costs and time for full HACCP implementation varied from plant to plant based on previous physical adjustments of plants and staff training along with specific requirements to be reached. In the short term, as market requirements for food safety not always were related to price improvement and the cost effectiveness not always was positive to the enterprise implementing HACCP. However, in the long term, this implementation might be the only way to keep plants as suppliers to the food market.

Calatore and Caswell (1999) reported from studies in the seafood industry that many companies failed to have a reliable costs and benefits estimation of HACCP implementation beforehand. These authors explained this failure based on indirect costs not defined in the US Food and Drug Administration (FDA) protocol as well as on specific requirements raised from their own business deals. They concluded that the uncertainty on costs and benefits estimations could be a major restrain for planning HACCP adoption by individual seafood companies.

From a survey of the United Kingdom (UK) in dairy processing sector, it was identified that the main reason for HACCP implementation was to meet legal requirements, second reason was the interest of the dairy companies in keeping their customers, by showing them that the company was following sophisticated hygiene practices while prices were little affected due to a better internal efficiency. Major cost of HACCP implementation in dairy processing companies was increase of staff time, while the major difficulty reported was staff training. These industries pointed out that the retention of existing customers was the major benefit of HACCP implementation (Henson, Holt, & Northen, 1999a).

This study offers the first information about the costs and benefits of HACCP implementation by the Mexican meat industry. The objective was to analyze the degree to which the HACCP system has been implemented by the meat industry, and the relationship between HACCP implementation and ISO 9000. In addition, it also indicates the importance of major costs, problems, and benefits of implementation and their impact on domestic and international markets.

2. Materials and method

Fieldwork was conducted following the methodology proposed by Henson, Holt, and Northen (1999b) with questionnaires adapted to the Mexican meat industry. The target population was all 160 TIF plants supervised by SAGARPA (1999). The questionnaires were sent by courier in 1999 to meat processing plants in the 25 Mexican states, which were divided into three regions. The north included Baja California, Chihuahua, Coahuila, Durango, Nuevo Leon, Sinaloa, Sonora and Tamaulipas. The center included Aguascalientes, Federal District, Mexico, Guanajuato, Hidalgo, Jalisco, Michoacán, Morelos, Puebla, Queretaro, San Luis Potosi, Tlaxcala and Zacatecas. Finally, the south included Chiapas, Tabasco, Veracruz and Yucatan. Only 92 surveys were fully answered, since the amount was above 50% of the total population, it was decided to work with this sample. In addition to general information, the questionnaires asked about aspects related to costs, benefits and difficulties of HACCP implementation. The respondents ranked these factors in order of importance according to their own conditions.

3. Results and discussion

The 92 fully answered responses represented 58% of the population of Mexican TIF plants. These plants reported five types of processing (Table 1). The most important were slaughter 42.4% (39 companies), prepared meals 28.3% (26 companies), and cold cuts 23.9%

Table 1
Number of meat and species processes among survey respondents

Processes	Number of plants	Percentage (%)
<i>Meat processes</i>		
Cold cuts	22	23.9
Packing	3	3.3
Pasteurized eggs	2	2.2
Prepared meals	26	28.3
Slaughter	39	42.4
<i>Species processes</i>		
Cattle	23	25.0
Cattle–pork	8	8.7
Cattle–pork–poultry	8	8.7
Horses	3	3.3
Pasteurized eggs	2	2.2
Pork	35	38.0
Poultry	13	14.1

Table 2
Survey respondents by number of employees in three Mexican regions

Number of employees	Region			Number (%)
	North	Center	South	
10–200	28	25	5	58 (63.0%)
201–500	10	11	3	24 (26.1%)
More than 501	6	3	1	10 (10.9%)
Total number of plants	44	39	9	92 (100%)

(22 companies). Seven species were registered among the 92 Mexican Federal Inspection Type (TIF) plants. The largest shares of enterprises were in pork (38.0%), cattle (25.0%), and poultry (14.1%).

The sizes of the plants surveyed from the three regions are detailed in Table 2. Using FSIS (1996) criteria, 63.0% of the enterprises were small (up to 200 employees), only one of these plants, in the north region, had less than 10 employees. Medium size plants (201–500 employees) comprised 26.1% of the sample. Only 10.9% were large (over 501 employees). Interestingly, the north and central regions dominated in terms of the number of enterprises in the sample.

3.1. HACCP and ISO 9000 status

Adoption of the food safety systems among the sample of TIF plants is summarized in Table 3. In 1999, 18.5% of the enterprises had the HACCP system in full operation. Another 29.3% were implementing HACCP, while 32.6% of the enterprises were planning to adopt HACCP but had not yet developed a specific plan. The remaining 19.6% had no plans to implement HACCP since they were in the process of implementing it or had no plans to adopt the system. Of the 17 enterprises that have HACCP in full operation, seven (7.6%) have

Table 3
HACCP and ISO 9000 adoption by plants responding to the survey

HACCP status	HACCP# (%)	ISO 9000# (%)
Fully operational	17 (18.5%)	7 (7.6%)
Being implemented	27 (29.3%)	6 (6.5%)
Planned but not implemented	30 (32.6%)	0 (0%)
No plans to implement	18 (19.6%)	0 (0%)

adopted ISO 9000 while only six (6.5%) of the 27 that were implementing HACCP had adopted ISO 9000 (Table 3). All these enterprises responded that they had first adopted ISO 9000 and then moved to the implementation of HACCP because they found this to be the easiest way to get full operation of the HACCP system in their plants.

The proportion of sales directed to international and domestic markets varied by HACCP adoption status (Fig. 1). Enterprises with fully operational HACCP indicated that 43% of their sales were directed to the USA, Asia, Central America, and Puerto Rico. Some domestic niches pay higher prices for meat quality. Those enterprises that were in the implementation process reported 34% of their sales to the USA, Japan, Korea, Cuba, Australia, Central America, and domestic niches. Those enterprises that were in the planning stage with no development of the system indicated that 18% of their sales went to the USA, Japan, Central America, Puerto Rico, China, and domestic niches. Access to international markets, specially USA, of these latter enterprises was due to a grace period giving from these markets before mandatory implementation of HACCP. Finally, enterprises with no plans to implement HACCP reported 75% of their sales to Japan and to domestic customers dedicated to the retail sale of Japanese food. Japanese market had no mandatory requirement of HACCP systems implementations in slaughterhouses; this explains the high proportion of sales to the Japanese market from plants with no HACCP implementation.

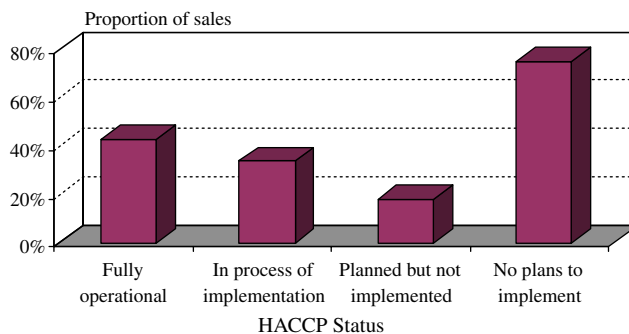


Fig. 1. Proportion of sales to export and domestic niches markets by HACCP status.

4. The costs and benefits of implementing and operating HACCP in the Mexican meat industry

The 17 enterprises with HACCP in full operation were included in the analysis of the costs, benefits and difficulties of implementation. The respondents were presented with a list of six different costs of implementing HACCP and asked to rank them in order of importance (with one being very important and six unimportant). Because some respondents gave the same rank of importance to more than one type of cost, mean scores given by the group of respondents were taken for the analysis. The costs of implementing the HACCP system can be divided into three groups by order of importance (Table 4). The most important type of cost was investment in new equipment (score of 1.8). Costs related to contracting external consultants and staff time spent on documentation were classified in the second group (scores of 2.3 and 2.5, respectively). The third group comprised the costs of personnel training (score of 3.5). The results suggest that the circumstances of the individual enterprises and the standards in place before adopting HACCP have significantly affected the costs associated with plant improvement, consulting, and the time spent on documentation. However, it is interesting to note that the cost deemed least important by the sample was staff training. Mexican market has high availability of hand-labor, while modern and sophisticated equipment comes from abroad. This situation could explain why in this study, equipment and not staff was the major cost in this stage of implementing HACCP, while Henson et al. (1999b) pointed out that in the UK dairy processing industry staff-related costs were of major importance.

Fourteen (82.3%) of the 17 enterprises had conducted a formal study of implementation costs before development and implementation of HACCP in their plants. For all 17 plants, their expectations of the implementation costs were surpassed in some cost categories (Fig. 2). Most notably, 71% responded that staff time spent in system documentation was greater than expected, while 59% underestimated the cost of external consultants. In contrast, only 29% of the respondents underestimated changes in management. In other cost categories, 12 and

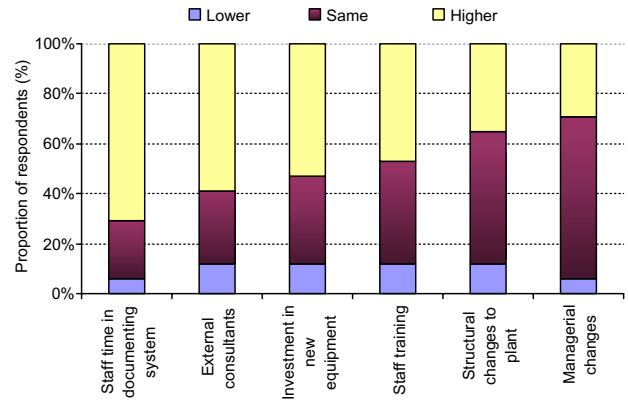


Fig. 2. Comparison of actual to expected costs of implementing HACCP.

11 respondents (71% and 65%, respectively) said that their costs were the same or lower than expected for managerial changes and structural changes in their plants.

Respondents were showed four cost items of operating HACCP, these cost items were suggested from previous field experiences (FSIS, 1996; Henson et al., 1999b). They were then asked to rank these cost items in order of importance, a score of *one* meant major importance and of *zero* if item was not important, respondents were allowed to give a score of one to more of one item (Table 5). From the four cost items showed, product testing was indicated by 70.6% of respondents as the cost item of major importance in HACCP operating, and in second place, staff training with 23.5% of the respondents. On the other hand, 35.3% indicated that managerial/supervisory time was irrelevant as cost item in operating HACCP. They were also asked whether their costs of production had changed as a direct result of HACCP implementation. Seventy-one percent answered that their total costs of production had increased, but for 6% these costs had decreased, with the rest of the respondents (23%) indicated no change in their costs.

Many of the respondents (13 of 17 or 76.5%) had formally estimated operating costs prior to developing HACCP in their plants. However, operating costs were underestimated by all 17 enterprises (Fig. 3). It was

Table 4
Mean rank scores for the importance of different costs of implementing HACCP in the Mexican meat industry

Cost	Mean rank score ^a
Investment in new equipment	1.8
External consultants	2.3
Staff time in documenting system	2.5
Structural changes to plant	2.6
Managerial changes	2.8
Staff training	3.5

^a Where 1 = very important and 6 = unimportant.

Table 5
Percentage of respondents giving different HACCP operating costs a rank of 1 (major importance) and 0 (not significant)

Cost	% of Respondents giving	
	Rank of one	Rank of zero
Record keeping	11.8	11.8
Product testing	70.6	11.8
Staff training	23.5	17.6
Managerial/supervisory time	11.8	35.3

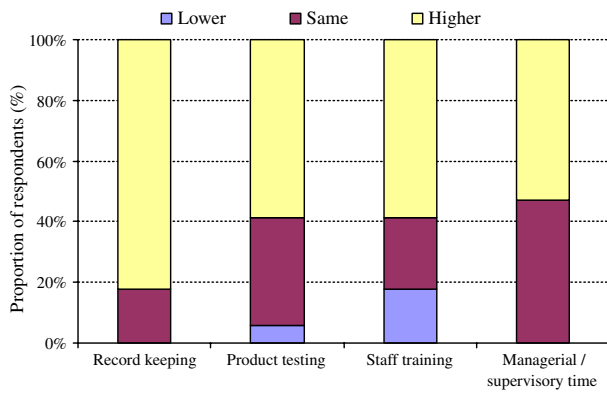


Fig. 3. Comparison of actual to expected costs of operating HACCP systems.

especially significant that 82% of the respondents underestimated record keeping and as a result exceeded their expected costs. Also, a large proportion (59% of the respondents) had difficulty in predicting product testing and staff training costs. Only 47% and 18% of respondents reported that managerial/supervisory time and record keeping were in line with their expectations, respectively; while 41.2% mentioned that product testing and staff training were similar to or lower than their expectations.

The results of the survey suggest that both HACCP implementation and operation costs exceeded previous budgeting. It is important to point out that staff time spent on documenting the system and record keeping, which are intangible concepts, are closely associated with tangible costs such as personnel training and structural changes in the plant. It is possible that respondents had problems in objectively identifying costs associated with HACCP implementation.

The 17 enterprises with HACCP in full operation were asked to rank (from one for major importance to eight for minor importance) the difficulties faced in implementing or operating HACCP. The results suggest that the major difficulties were associated with staffing (Table 6). The two most important factors were the need to retrain production and supervisory/managerial staff (1.7 and 2.7 respectively), followed by attitude/motivation of the production staff (3.4) and of the supervisory/managerial staff (3.7). On the other hand, reduced flexibility for introducing new products and production staff were perceived as difficulties of minor importance in the implementation/operation of HACCP (4.0 and 4.2 respectively). In both processing industries: Mexican meat and UK dairy (Henson et al., 1999a), qualified that staff was the major restraint to implement/operate HACCP in plants.

Regarding benefits of implementing and operating the HACCP system in meat processing plants, the 17 enterprises with HACCP in full operation were asked to rank a list of benefits from 1 to 11, with 1 being very

Table 6

Mean rank scores for difficulties faced when implementing/operating HACCP

Factor	Mean rank score ^a
Need to retrain production staff	1.7
Need to retrain supervisory/managerial staff	2.7
Attitude/motivation of production staff	3.4
Attitude/motivation of supervisory/managerial staff	3.7
Recouping costs of implementing HACCP	3.8
Reduced staff time available for other tasks	3.9
Reduced flexibility to introduce new products	4.0
Reduced flexibility of production staff	4.2

^a Where 1 = very important and 8 = unimportant.

important and 11 being unimportant. The main benefit was a reduction in microbial counts (average ranking of 2.6) which can be considered as tangible benefit, followed by clientele and product benefits, such as the ability to attract new customers (2.8), access to international markets (2.9), and prolonging product shelf life (2.9) which are less tangible than the first benefit mentioned before (Table 7). Ranked in the middle in terms of benefits were increased product sales, the ability of the enterprise to retain existing customers, increase in prices, and reductions in production costs. Motivation of the production staff (4.0), motivation of the supervisory/managerial staff (4.4), and waste reduction (5.3) were ranked as less important. The poor awareness of domestic market of food safety motivated that customer retention was not the major benefit as it was found in UK (Henson et al., 1999b). Instead, reduction in microbial counts was indicated as the major benefit in this industry.

Most of the benefits that the enterprises received with the implementation and operation of the HACCP system were greater than their expectations (Fig. 4). Of the enterprises with HACCP in full operation, 71% of the respondents reported that actual benefits exceeded expectations in four items: increased product shelf life, increased ability to retain existing customers, increased ability to attract new customers, increased ability to

Table 7

Mean score for the benefits of implementing/operating HACCP

Factors	Mean rank score ^a
Reduced product microbial counts	2.6
Increased ability to attract new customers	2.8
Increased ability to access new overseas markets	2.9
Increased product shelf-life	2.9
Increased product sales	3.3
Increased ability to retain existing customers	3.3
Increased product prices	3.5
Reduced production costs	3.5
Increased motivation of production staff	4.0
Increased motivation of supervisory/managerial staff	4.4
Reduced product wastage	5.3

^a Where 1 = very important and 11 = unimportant.

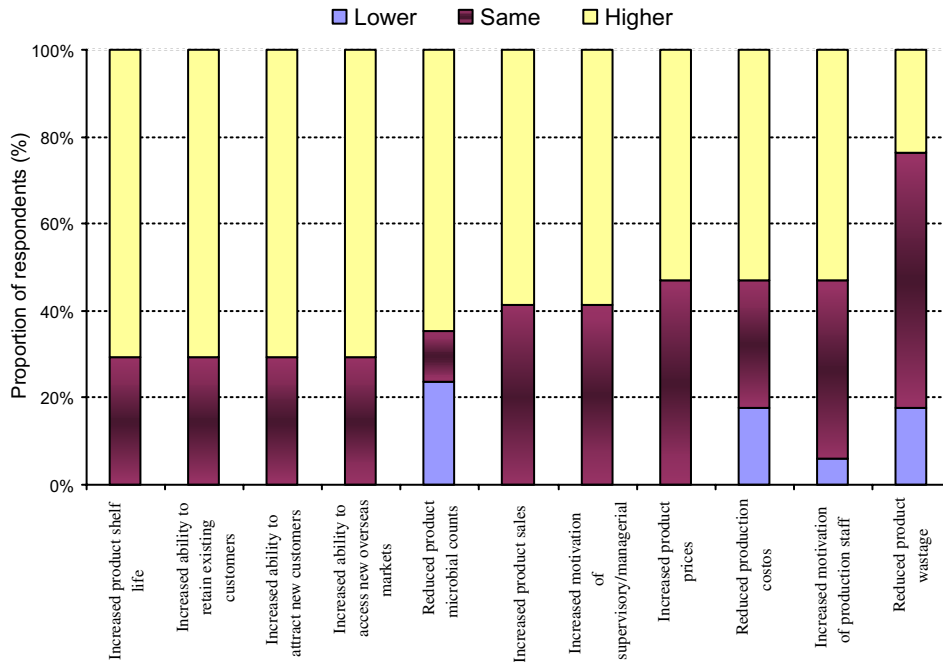


Fig. 4. Comparison of actual to expected benefits of implementing/operating HACCP.

access new overseas markets. Further, 65% reported that the reduction in microbial counts was greater than expected. Eight companies (47%) declared that increase in product prices was expected, while seven (41%) indicated greater than expected increases in product sales and in motivation of supervisory/managerial staff. Thirteen (76%) reported that their benefits were the same or lower than expected for reduced product wastage and eight (47%) for an increase in the motivation of production staff and reduction in product costs, respectively. Only six (35%) had a reduction in product microbial counts when implementing/operating HACCP in their plants the same or lower than expected.

It is important to point out that most of the enterprises have had difficulties in detecting, quantitatively, the impact of HACCP on their industrial processes. For some of them it has been difficult to isolate the impact of HACCP from other changes that were carried out simultaneously in their plants. Therefore, the higher than expected levels of certain benefits, such as the ability to attract new customers and retain existing clients, should be regarded with caution. In addition, there is evidence that a high proportion of the meat-processing enterprises interviewed do not formally monitor costs derived from insuring food safety and quality.

5. Conclusions

This study reports the first assessment of costs and benefits associated with the implementation of HACCP in the Mexican meat industry. In the group of enter-

prises with the HACCP system in full operation, there was advanced voluntary implementation. Also, the prior adoption of ISO 9000 had a direct influence on the implementation of HACCP for these firms. For implementation, it is important that enterprises have the information necessary to evaluate concretely the magnitude of the costs in each type of plant prior to implementation.

The local public interest has not been the major reason of the implementation of HACCP systems in the Mexican meat industry. Implementation of HACCP has been to meet requests from international markets and very specific domestic niches. If the Mexican meat industry waits to local public demand to adopt HACCP, it might be too late and the foreign industry can be turned as a threat to the Mexican industry. Then, in a globalized trade to hold HACCP implementation until local demand arises can curtail local meat industry production. In the short term, Mexico will have to play an important role in trade, particularly on the American continent. Thus, those enterprises, in particular small businesses, that do not take the necessary measures to implement the HACCP system will slowly be left out from the market, including the domestic market. This study provides important data on costs, difficulties, and benefits involved in HACCP implementation and operation.

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