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Studies of Beef Slaughter and Meat Processing

Neal H. Hooker*,

Rodolfo M. Nayga Jr.,

John W. Siebert

DEPARTMENT OF AGRICULTURAL ECONOMICS
TEXAS A&M UNIVERSITY
COLLEGE STATION, TEXAS

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Neal H. Hooker*, Rodolfo M. Nayga Jr., and John W. Siebert

Texas A&M University

email: rnayga@tamu.edu

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Neal H. Hooker, Rodolfo M. Nayga Jr., and John W. Siebert

Department of Agricultural Economics, Texas A&M University

Abstract

As livestock producers adopt risk mitigation strategies for veterinary drug residues and microbial pathogen contents in and on animals presented for slaughter it is essential that these food safety gains are not eroded downstream. Such production efforts must be matched with enhanced coordination and communication between all the elements of the supply chain. This paper assesses the economic implications of changes in the slaughter-processing stage(s) suggesting potential hurdles to the development of "farm to table" food safety systems. The costs and benefits of quality assurance systems (and in particular those based on HACCP) for these intermediate stages is also presented. Material from two surveys supplies evidence from beef slaughter and meat processing plants in Australia and the United States.

Keywords

beef slaughter and meat processing, food safety attributes, risk communication, quality assurance

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Introduction

Various commentaries have advocated the use of enhanced information sharing between livestock producers and their customers, be they first handlers, processors, retailers, or the final consumer to help address microbial food safety concerns (see, e.g., Hueston and Fedorka-Cray 1995 and Buchanan, Acuff, and Halbrook 1995).

As livestock producers respond by adopting risk mitigation strategies for veterinary drug residues and microbial pathogen contents in and on animals presented for slaughter it is essential that these farm-level food safety gains are not eroded downstream. The greater initial control of microbial contamination pre-slaughter fits neatly into the recent stage- and sector-specific HACCP-based regulatory regimes (e.g., USDA 1996). Indeed without evidence of such practices producers risk the rejection of whole lots or herds upon delivery due to food safety concerns arising from processors Hazard Analysis and Critical Control Point (HACCP)-based systems.

Combined these elements demonstrate the importance of a close dialogue between slaughter-processing plants and their customers and suppliers on all issues that can impact food safety. Key factors at the slaughter-processing stage(s) include: co-mingling of animals prior to slaughter; lot size and identification on the slaughter floor, animal to carcass and carcass to cut traceability; as well as general plant hygiene, sanitation, and food safety activities. This paper assesses the economic implications of changes in these stages suggesting potential hurdles to the development of “farm to table” food safety systems.

Demand for Traceback

It is well documented that simple spot markets do not provide sufficient incentives to improve the quality of agricultural products prompting the use of more complex vertical coordination mechanisms (see, e.g., Hennessy 1997). Reacting to this, and the opportunity to differentiate meat products based on firm reputation and brand recognition slaughter and processing plants are considering how to encourage tighter links with their suppliers and customers. The traceback issue has received considerable attention in the UK (Calder and Marr 1998) and Canada (Spriggs and Hobbs 1997) and has started to gain momentum in the US (see, e.g., Billups, Zabawa, and Orwyang 1999). In fact, there are now proposals to implement a National Cattle Identification (NCID) system for America's cattle producers, feeders, and processors to facilitate transfer of carcass data to the producer, to enhance seedstock and cow/calf producers opportunity to make genetic and management decisions, and to assist feeders in marketing cattle to better fit market end-points. Source verification is obviously another benefit of a traceback system.

The potential for food safety communication efforts to serve as one such form of vertical coordination and act as positive marketing tools which focus on the producer-processor exchange, is raised in Roberts et al. (1997):

> A major coordination task for first handlers and food processors is to influence production practices in ways that contribute to improved safety. This involves: (1) identifying and communicating the common good to be shared through changing the production practice; (2) delivering educational services that introduce incentives to promote changes; (3) designing economic incentive systems (e.g., price premiums or penalties) that encourage changes; and (4) providing support mechanisms for producers in newly emerging markets (e.g., producer roundtables) (p.168).

Various production practices can be employed in an attempt to influence the microbial profile of

cattle and hence the safety of meat products. These include feed and water controls (Food and Agriculture Organization 1997), manure utilization, genetics and animal husbandry, housing, and herd management (Hancock et al. 1997). Clearly, once such practices have been adopted it is in the interest of processors and producers (point 2 above) to ensure that an "identity preservation" system that distinguishes cattle raised under such environments is in place. Ideally, such a system would facilitate some degree of "traceback" whilst also addressing points 3 and 4.

Within this Roberts et al. framework this paper discusses such examples of the role of food safety communication by beef slaughter and meat processing plants in Australia and the United States. Material from two independent surveys conducted by researchers at Texas A&M University is presented.

The Case of Australia

The Australian beef production, slaughter, and processing industries have undergone significant advances over the last decade. A true focus on quality assurance (QA) at the slaughter and processing stages has promoted additional communication with producers over veterinary drug residues and, now more frequently, general animal cleanliness. To gain a better perspective of the role of food safety communication, a survey of Australian beef slaughter plants was conducted as part of a larger study considering process modification costs for slaughter floors. A total of 98 questionnaires were mailed in early 1999. The responses of 41 plants are discussed here and include information from a representative range of plant sizes, single and multi-species operations, and those supplying domestic and foreign markets.

On Identity Preservation

The plants were questioned about their general perceptions of identity preservation and then provided a more discrete example of what may be involved in such a (chain-wide) system. It is interesting to compare these results. First, Table 1 reports the results of the general question "How feasible do you think it is to enhance identity preservation capabilities in your plant?" 26 plants believed that such a change would be very or moderately feasible, 9 slightly feasible, and 3 not feasible (3 did not respond). Little difference between the responses of domestic and export plants can be discerned. Common obstacles to the development of enhanced identity preservation capabilities in these plants included generic answers relating to the associated time, resources, and costs of such systems and more specific concerns such as the lack of traceability of livestock between producers, loss of identity in the boning room, purchasing channels through auctions, variance in supplies, and limited technologies available.

The more specific question asked "Do you think it will ever be possible to identify the source animal (and all its production history) via a bar-code on a consumer ready meat product?" This question implies the broader chain-wide elements of a traceback system. Firms were given a yes-no response and if answering no were asked to suggest the main obstacles to implementing such a farm to table system. 29 answered yes and 11 no (with 1 non response) with very similar responses from both domestic and export plants (see Table 2). Given the larger share of negative responses these data seem to indicate that once the details of a full traceback system are understood there is more opposition by slaughter-processing plants (who are most likely to bear most of the costs of such farm to table systems). Those answering no indicated similar obstacles as raised in the earlier question. Indicative development costs of between (A)$40-$100,000[2]

[2] A typical exchange rate is A$1=US$0.66.

arising from electronic identification systems, documentation, labor, and management time were most frequently mentioned.

Enhancing Food Safety Communication

Plants were asked how food safety communication with their suppliers could be improved. Common suggestions included; developing a single document to supply all information, everything should be sold on direct consignment thereby avoiding auctions, increasing the number of meetings with (and audits of) producers, and promoting the individual identification of cattle along with their husbandry history. Refreshingly, one respondent mentioned that specific company requirements are outlined and thereby not left to chance. Industry magazines were most commonly cited as the best resource to utilize in promoting these activities.

The average number of customers serviced by the plants was over 70 and ranged from 2 to more than 300. Most plants deal with at least 20 customers indicating the complexity of any traceback system. The relationship with these customers was equally distributed over fixed volume contracts and dealings with wholesalers or brokers. More than half of the plants also reportedly undertake service kill for customers and four dealt directly with food service companies.

When questioned about how food safety communication efforts with these customers could be improved respondents stressed the role of: what documentation follows product; the training of wholesalers and retailers to learn about cross contamination, time, and temperature controls; constant feedback through an increased number of audits, person to person contacts, and visits to facilities; and fully understanding customer handling procedures and product end-use. Methods to communicate these issues included questions of plant QA departments, industry fairs, marketing magazines, brochures, and meetings.

Finally, plants were asked about their current use of incentive systems. 19 plants do, and 18 do not, offer their suppliers premiums based on certain quality characteristics of the livestock they purchase. Common examples included pricing grids for weight, fat score, meat color, marbling, grain assisted livestock, butt shape, and breeds specific to Asian markets. Price penalties for livestock outside specification especially if stock are dirty and require excessive trimming were commonly mentioned.

On QA Adoption

Various information relating to QA was collected by the survey. A range of systems (mostly based on HACCP principles) were reported. Prior to implementation these plants mostly relied on inspectors for quality assurance activities. On average the plants took 24 months to implement their chosen QA system. Only 14 of the 41 plants mentioned that they used an external advisor in preparing their QA system. The average cost of adoption was approximately A$8,000. However, as the number of hours of management time required varied from the tens, hundreds, thousands, to 'countless' numbers of hours it is extremely difficult to accurately determine all costs.

Plants were asked to rank the importance of eight cost centers that can be affected by microbial pathogen reduction strategies and to then suggest which function (out of a list provided) within each cost center was the most important. Table 3 presents these average rankings over each center and the most commonly cited functions within each category. The first two cost centers are human capital related, re-iterating a common theme in the literature of the role of labor costs in affecting the adoption of effective food safety activities in slaughter operations.

Administration costs (which can also include internal testing and verification practices) were considered to be of reasonable importance, and encouragingly the up-dating of QA plans

was stressed by more than half of the respondents as being the most important function within this cost center. Interestingly only 10 respondents thought that purchasing new equipment was an important part of their food safety efforts. Finally, it is interesting to note that input prices are considered the least important cost center by respondents. Thus one may presume that additional costs of animals due to production changes will be absorbed by slaughter operations if it can be proven that there is a true food safety gain.

Food Safety Concerns of Small Meat Processors in Texas

The small meat processing sector is a vital agribusiness industry in Texas. Many of these meat processing plants are owner-operated and can be defined as either "very small" (less than 10 employees) or as "small" (10-499 employees). Processed meat products are high-valued goods which can offer small meat processors an opportunity to make better returns. Currently, however, there exist institutional and marketing constraints that have limited the growth of small processing plants in Texas. Food safety is definitely a major issue in the industry, especially with the HACCP implementation required of all very small firms by January 2000.

A second Texas A&M University mail survey of 65 small meat processors in Texas was conducted during spring 1999 to partly examine food safety concerns. The focus of this survey was on small sausage and smoked processed meat processors. These firms concentrate on meat processing steps such as seasoning, blending, grinding, smoking, cooking and packaging with only a few of these firms slaughtering cattle. In addition to the primary activity of meat processing, a few of these firms operate meat markets, restaurants, and/or small food distribution businesses. These firms source raw meat in bulk from a relatively small number of firms.

The number of meat processing plants in Texas declined by about 43 percent from 1982 to

1996. There is, therefore, great concern in the industry on how to enhance the profitability of small meat processing plants. These small businesses represent an important part of the character of Texas' rural economy. Yet, these businesses have been the focus of little or no market research in the past. Texas is the second largest state in the nation in terms of population and its urban population is soaring, creating numerous food sales opportunities. Paradoxically, the state's rural population is searching for profitable agribusiness opportunities to help revive its economy.

Certified Supplier Demands and Traceback Issue

As scientific knowledge increases and this in turn raises the food safety awareness of the final consumer, food retailers, restaurants and distributors are driven to improve food safety. This effort results in new demands being placed upon food manufacturers to become "certified suppliers." Due to the presence of in-house quality control staff, large manufacturers are better equipped to deal with these demands than are small processors.

Food safety demands are being placed upon small Texas meat processors via customer demands including: federal/state inspection, legal agreements regarding quality, customer inspection of facilities, standards exceeding USDA norms, and capability to trace raw product lots (or traceback). Generally, as plant size increases the percentage of customers demanding certification in these areas also increases. Respondents were therefore asked what percentage of their customers demand "...the tracing of raw product lots that make up the final product." The average is only four percent. The majority of the customers (56%) require federal or state inspection instead (see Table 4). An average of about 10 percent of the customers require a signed legal agreement regarding quality indemnification and an average of another 10 percent require either customer inspection of the plant or standards exceeding those set by USDA.

Table 4 presents a cross tabulation between annual dollar sales and the customer demands mentioned above. The last column is a tabulation of annual sales and traceback information. Based on the information from this column, 21 of the 44 responding firms have sales of between 1 to 5 million dollars and the average percentage of the firms' customers requiring traceback information is only 3 percent. However, the range of the percentage of customers requiring traceback information from these 21 firms with annual sales of between 1 to 5 million dollars is zero to 50 percent. This result indicates that although there is a relatively low demand from the customers, on average, for traceback information, some of these firms are already facing demands for traceback information from half of its customers. This finding may reflect the growing sentiment for a national traceback system similar to those adopted in the UK and Canada to facilitate value-based marketing.

Information Relative to HACCP Implementation

In an effort to realize economies of scale or to support multiple family generations, small firms seek to grow their sales volume. However, in their quest for growth they face the present challenge of conforming to new HACCP guidelines. Hence, the survey included questions related to HACCP implementation. Based on the survey results, about 20 percent of the 65 small meat processors interviewed had implemented HACCP in January 1999 while about 66 percent are gearing up for HACCP implementation by January 2000. The rest are custom exempt and, therefore, are not implementing HACCP on their plants. About half of the responding processors have indicated that they will either modify/add on to current facility or build new facility to be in compliance with HACCP. About half of the responding firms will also spend at least $2000 to train staff for HACCP. The firms will have an average of about two trained HACCP employees. Interestingly, about 30 percent of the responding firms will discontinue some products due to

HACCP. As presented in Table 5 the majority of the responding firms (70%) project the total cost of implementing HACCP to be between 1 to 5 cents per pound of product produced.

Concluding Remarks

Food safety issues have become a major concern for consumers and producers alike. These concerns have been heightened by extensive media attention and growing general awareness of the relationship between diet and health. Hence, despite overwhelming scientific data and evidence attesting to the safety and effectiveness of certain production practices, many consumers remain concerned about their use in food production or processing. Consumer resistance might be diminished if risks eliminated by certain production practices are clearly communicated and explained (Nayga 1996). In this paper, we provide evidence of the role of food safety communication within a system increasingly dependent upon HACCP-based QA systems, and how producer innovations to improve the microbial profile of cattle can be preserved to improve food safety. This paper discusses examples of the role of food safety communication by beef slaughter and meat processing plants in Australia and the United States. Even though the US is in the early stages of developing a national cattle identification system, these types of initiatives will increasingly become important if ever the industry is to have a value-based marketing program that aims to increase market share and consumer confidence in US' meat quality and safety at both the domestic and international levels.

Each of the vertical coordination mechanisms, obstacles, and concerns of stakeholders discussed above need to be considered further in order to determine how food safety gains at each stage of the supply chain can be both preserved downstream and effectively communicated. The key is the chain-wide *communication* and *utilization* of all available information, its expanded

role within a system increasingly dependent upon HACCP-based QA systems, and how such farm-level innovations to improve the microbial profile of livestock can be preserved to improve food safety. For regardless of the best efforts of producers to control food safety, their influence ends at the farm gate, a point well made by Kliebenstein:

> The focus on the effort that is needed to associate farm management strategies with pathogen levels is noteworthy and needs to be pursued. For many onfarm pathogen reduction practices to be effective, the food channel must be structured so that there is less chance of cross-contamination further up the food channel once the pathogen levels have been reduced at the preharvest or farm level. (1995, p.90)

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Table 1. General Question - Feasibility of Enhanced Identity Preservation Capabilities in Plant

Type of Plant	Very Feasible	Moderately Feasible	Slightly Feasible	Not Feasible	No Response
Domestic	7	7	6	1	3
Export	3	9	3	2	0
Totals	10	16	9	3	3

Table 2. Specific Question - Is “Full” Traceback (Source Animal to Retail Meat Cut) Possible

Type of Plant	Yes	No	No Response
Domestic	17	6	1
Export	12	5	0
Totals	29	11	1

Table 3. Ranking of Cost Centers and Functions of Importance in Food Safety Efforts

Cost Center	Function	Number of Responses
1. Training	Skills training for new staff	17
	On-going training for current staff	17
2. Labor	Line staff	25
3. Analytical Services	In-house microbiological testing	23
	Contract microbiological evaluations	8
4. Inspection	Mandatory 3rd party audits	9
	Internal verification	24
5. Administration	Up-dating QA plan	23
6. Capital Investment	Building/line re-design	16
	Purchasing equipment	10
7. Maintenance	Scheduled/routine	20
	Unanticipated	8
8. Input Prices	Animals	10
	Utilities (electricity, water, gas, steam etc.)	16

Table 4. Processors' Average Annual Sales and the Average Percentage of Customers Requiring Specific Food Safety Demands

Annual Meat Processor Sales	Federal/State Inspection	Legal Agreement Regarding Quality	Customer Inspection of Facility	Standards Exceeding USDA	Tracing of Raw Product Lots
$50,000 - 250,000	29% 0 - 100% (7)	0% 0% (6)	1.5% 0 - 9% (6)	0% 0% (6)	0% 0% (6)
$250,000 - 500,000	49% 0 - 100% (10)	0.63% 0 - 5% (8)	5.62% 0 - 25% (8)	11.42% 0 - 80% (7)	1.42% 0 - 10% (7)
$500,000 - 1 million	57.78% 0 - 100% (9)	6.25% 0 - 25% (4)	2.60% 0 - 5% (5)	2.50% 0 - 10% (4)	2% 0 - 5% (4)
$1 million - 5 million	52.73% 0 - 100% (22)	15.91% 0 - 100% (22)	6.65% 0 - 100% (20)	5% 0 - 100% (20)	3% 0 - 50% (21)
Over $5 million	64.75% 5 - 100% (8)	21.43% 1 - 100% (8)	21.43% 0 - 100% (7)	21.67% 0 - 100% (6)	16.43% 0 - 50% (7)
Overall Mean	56	10	6	5	4

Note: Companies were asked to respond out of 100% from each requirement

Table 5. Frequency Tabulation Presenting the Number of Firms by Average Annual Firm Sales and Projected Total Firm Cost of Implementing HACCP

Annual Meat	HACCP Cost in Cents per Pound						Total
Processor Sales	1 - 3	3 - 5	5 - 7	7 - 10	10 - 13	13 +	Firms
$50,000 - 250,000	2	0	0	0	0	0	2
$250,000 - 500,000	5	3	0	0	0	1	9
$500,000 -1 million	0	2	3	0	3	0	8
$1 million - 5 million	11	5	3	3	2	1	25
Over $5 million	3	5	0	0	0	1	9
Total Firms	21	15	6	3	5	3	53