

# Food safety and its impact on domestic and export markets

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## Summary

The issue of food safety in the United States has been fomented in recent years by highly publicized outbreaks of foodborne disease. These outbreaks have stimulated revision of Federal regulations for food inspection in packing plants, and spawned consumer groups advocating the control of foodborne pathogens in animal production systems. The United States has recently become a net exporter of pork, and quality assurance of product is becoming a focus of competition in export markets. This paper examines historic and current controversies over *Trichinella* and United States pork exports to Europe in the 19th century, bovine spongiform encephalopathy in the United Kingdom, *Escherichia coli* O157:H7 in the United States, and organochlorine residues in Australian beef to illustrate the profound effects that perceptions of food safety can have on consumer attitudes, government regulations, and market access. The implications of the United States HACCP/Pathogen Reduction Act of July 1996, recent international agreements promoting free trade (General Agreement on Tariffs and Trade [GATT], North American Free Trade Agreement [NAFTA]), and implementation of quality assurance programs by leading pork-exporting nations are discussed in the context of industry competition in domestic and international markets.

**Keywords:** swine, food safety, trade, market, domestic, international

**Received:** October 15, 1996

**Accepted:** January 8, 1997

For over 100 years, food safety has played a significant role in the acceptance of United States pork by domestic and export markets. This paper reviews some historical and current aspects of food safety and their potential impact on efforts by the United States pork industry to expand its share of the global animal-protein market.

Almost everyone has an interest in the safety of the food supply, firstly as consumers and secondly as taxpayers who fund its regulation by the Food Safety Inspection Service (FSIS) of the United States Department of Agriculture (USDA). Food animal producers and veterinarians should have added interest in food safety issues because of the potential effect of public perceptions of product safety on consumer demand, in both domestic and export markets. The United States swine industry recently progressed from being a net importer to a net exporter of pork. From 1994 to 1995, pork exports increased 49%, adding \$9.25 to the value of each hog.<sup>1</sup> Owing to the relatively low cost of producing pork in the United States, the outlook for continued growth

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of pork exports is very positive, provided that the industry is competitive on quality, including assurance of food safety.<sup>2</sup> Success in export markets is crucial to sustaining prices, and the viability of all swine producers in this growing industry. Pork is recognized as a source of several pathogens considered to be the most important agents of foodborne disease in the United States.<sup>3</sup> (Table 1)

Recent events that have increased the importance of food safety issues to swine producers include:

- highly publicized outbreaks of foodborne disease in the United States and overseas,
- new regulations for control of foodborne pathogens in packing plants,
- advocacy by consumer groups to control foodborne pathogens in animal production systems,
- international trade agreements promoting freer trade, and
- implementation of quality assurance programs by other pork-exporting countries.

**Table 1**

Major foodborne pathogens in the United States, and relative importance of pork as a source

Pathogen	USDA Ranking*	Relative importance of pork †
<i>Salmonella</i>	1	++
<i>Campylobacter</i>	2	+
<i>Toxoplasma gondii</i>	3	+++
<i>E. coli</i> O157:H7	4	-
<i>Listeria monocytogenes</i>	5	+
<i>Trichinella spiralis</i>	6	++++
<i>Yersinia enterocolitica</i>	6	++++

\* Anon, 1995<sup>3</sup>

† Subjective scale where:

++++ indicates that pork is unquestionably the main source among meats (excluding game);  
 +++, pork is considered the main source, but other sources are also important;  
 ++, pork is not the main source, but is still considered an important source;  
 +, pork is a known source but other sources are thought more important; and  
 -, pigs have not yet shown to be a source.

# Food safety and politics: The old and the new

The importance of foodborne disease in limiting market access has a long history and is not a modern phenomenon that will go away if ignored. The complexity of food safety issues is well illustrated by the history of *Trichinella* and United States pork exports 100 years ago,<sup>4</sup> the current issue of bovine spongiform encephalopathy (BSE) in the United Kingdom, and the ongoing concerns about *Escherichia coli* O157:H7 in the United States.

## The old: *Trichinella* and United States pork exports, 1860–1906

From 1860–1880, large outbreaks of human trichinosis in Germany resulted in 8000 cases, with over 500 deaths. German authorities decided that consumers could not be required to cook all pork products, and attempted to control the disease by providing consumers with a product that would be safe even if uncooked. Governmental actions taken to ensure pork safety included:

- making the sale of *Trichinella*-infected pork in Germany illegal, and
- introducing mandatory microscopic examination of slaughtered pigs (trichinotomy).

Some butchers formed cooperatives to inspect carcasses and established funds to compensate for losses due to condemnations (which sometimes included bonuses for detecting infected pigs) and for legal protection.

In response to the German outbreak, Virchow — a famed medical and political figure — led a politically controversial campaign of public education and a crusade for trichinotomy. Trichinotomy was widespread in Europe by the end of the 19th century.

In contrast, in the United States trichinotomy was not adopted, perhaps because:

- there were no large outbreaks of disease;
- implementing a trichinotomy program was very costly, particularly in geographically dispersed slaughterhouses with relatively rapid rates of slaughter; and
- inspection methods were imperfect, and a ‘stamp of approval’ would give consumers a false sense of security.

In the 1880s, the United States became the largest pork exporter in the world. From 1879–1888, at least 10 European countries instituted embargoes on importing pork, predominantly because there was no trichinotomic inspection in the United States despite a high prevalence of the parasite. However, there is considerable evidence that the embargo was motivated at least as much by economic as public health motives. Within importing countries, political factions argued that the embargo was designed to protect wealthy entrepreneurs while denying cheap meat to poorer consumers.

In the United States, response to the European embargo took several forms. Some factions promoted the introduction of trichinotomy,

some suggested promoting exports by reducing tariffs on European goods, while some advocated retaliatory tariffs on imports. Eventually, trichinotomy was adopted in the United States for exported product, but not for product consumed domestically. The United States also reduced tariffs on some products, and eventually some European countries lifted the embargo.

In Germany, however, meat interests claimed that the American inspection system was inferior and successfully lobbied the German government to declare that pork imported from the United States had to be reinspected in Germany—obviously increasing its cost. The United States sent a scientific attaché to its embassy in Germany to address the problem in a scientific manner. The attaché recommended that the United States export only cured and inspected product, obtained endorsements of the United States inspection system from leading German scientists, and demonstrated that the German system was in fact inferior and that some human *Trichinella* cases had resulted from ingestion of product inspected in Germany. As a result of this study, the German restrictions were changed, but other barriers to trade appeared. Trichinotomy was abandoned in the United States in 1906.

A century later, although the prevalence of *Trichinella* in swine and the number of human cases in the United States have declined substantially,<sup>5</sup> the parasite is still present at low levels and constitutes a major impediment to exports. Companies exporting to Europe currently incur costs of either testing or frozen storage for varying lengths of time (according to country of destination). In some markets, even after freezing (which will kill *Trichinella*) the pork may not be sold as unprocessed product because it is not *Trichinella* ‘free.’

## The new: Bovine spongiform encephalopathy, 1986–1996

Much more recent historical events in the United Kingdom send us a powerful message about the potential consumer reaction to perceived health risks. A brief walk through the history of BSE can also teach us how perceptions shape consumer behavior, often with little regard for scientific information:

- In November 1986, BSE was identified as a ‘new disease’ of cattle, primarily older dairy cows, in the United Kingdom.
- BSE had many similarities to scrapie, a disease of sheep, and to other rare and poorly understood diseases termed ‘transmissible spongiform encephalopathies’ in other species, including humans (for example ‘Creutzfeldt-Jacob disease’ [CJD]).
- The origin of BSE was deemed to be the feeding of animal byproducts to cattle, although this hypothesis is not universally accepted. Changes in regulation of rendering processes in the United Kingdom were thought to have permitted infective material containing the scrapie agent to cause disease in cattle.
- Consumer studies showed about 30% of consumers changed their beef consumption patterns at the time of the ‘scare.’ Beef and sheep demand and prices remained poor through 1990–1991 in the wake of the publicity on BSE. Beef prices also dropped sharply in Ireland although no cases had then been recognized there. One 1993 study concluded that ‘public confidence in beef has been severely dented

and that the adverse effects of BSE remained prominent' and identified a 'distinct void in public knowledge on the subject of BSE and its human implications,' recommending that it was essential that 'the public be re-educated to the facts in the aftermath of the confusion.'<sup>6</sup>

- BSE was declared a notifiable disease in the United Kingdom in June 1988. Other regulatory procedures were instituted, including compulsory slaughter of suspect cattle and a ban on the use of their milk for human or animal consumption, and a ban on feeding ruminant-derived protein to ruminants.
- The incidence of BSE in cattle born after introduction of the regulations declined.<sup>7</sup>
- March 20, 1996: The British government announced a 'possible link between a new variant of CJD and exposure to BSE.' The 'link' was based on a report of 10 unusual cases of CJD lacking an obvious explanation.
- March 27, 1996: The European Commission imposed a worldwide ban on the export of British beef and beef products.
- McDonald's and other fast food chains in the United Kingdom announced a policy of using only imported beef in hamburgers.
- One beef breed association pointed out the absence of BSE cases in that breed.
- Tesco (a large retail outlet in the United Kingdom) launched a 'beef assurance scheme' through a nationwide producer group, incorporating traceback and other specifications at the production level linked to both product safety and animal welfare.
- At present, hundreds of thousands of cattle are being slaughtered and disposed of, as part of an agreement toward lifting of the embargo.

## More of the new: *Escherichia coli* O157:H7, 1982–1996

The emergence of *E. coli* O157:H7 as a foodborne disease causing the deaths of children after eating undercooked hamburger has had a profound impact on the politics of food safety in the United States. *E. coli* O157:H7 was first recognized as a human pathogen in 1982, after outbreaks in Oregon and Michigan were linked to consumption of ground beef sandwiches. Subsequent outbreaks in many other states and countries were predominantly linked to ground beef, but also unpasteurized milk and water.<sup>8</sup> Cattle, particularly dairy cattle, have been determined to be the primary reservoirs of infection.<sup>8</sup> Person-to-person transmission can result in significant spread (e.g., in day care centers and nursing homes). In a 1985–1986 survey of retail meats, Doyle and Schoeni<sup>9</sup> found 1.5% of pork samples — as well as beef, lamb, and poultry — to be positive for *E. coli* O157:H7, although the presence of the organism in pork is thought to have resulted from cross-contamination from beef. Pigs have not yet been found to be natural carriers of this organism.<sup>10</sup> Of 4339 fecal samples collected from 152 farms during the 1995 survey by the USDA National Animal Health Monitoring System, none tested positive for *E. coli* O157:H7.<sup>11</sup>

In 1992–1993, a large *E. coli* O157:H7 outbreak (530 cases, four fatalities) in western states linked to a fast food chain attracted nationwide media attention. As with the BSE scare in the United Kingdom, this

had an immediate and profound impact on the beef market. One fast food chain experienced a 30%–35% drop in sales in the 2 weeks following the scare. Within 3 weeks, consumer organizations had geared up their efforts, engendering a lawsuit against the USDA to require warning labels on meat. In response, federal and state public health agencies issued consumer advisories and held congressional hearings. The United States Secretary of Agriculture issued a statement that the meat inspection system needed to be improved, and President Clinton discussed the concerns in a nationwide address.<sup>12</sup> By 1993, the FSIS introduced regulations requiring safe-handling labels for meat. In July 1996, President Clinton signed the HACCP (Hazard Analysis Critical Control Points)/Pathogen Reduction Act, profoundly changing the process of meat inspection. Although initiation of these changes predate the 1993 *E. coli* outbreak, that occurrence undoubtedly accelerated the process.

A much larger *E. coli* O157:H7 outbreak in August 1996 in Japan now appears to have been traced to contaminated seaweed, but imported United States meat was an early target of suspicion and investigation is continuing.

Several important lessons are apparent from the history of these issues:

- food safety concerns can provoke radical responses from consumers;
- food safety concerns can result in profound regulatory responses from government;
- these responses can occur based on limited scientific evidence of a problem (e.g., BSE);
- food safety is a highly political area, nationally and internationally; and
- at all levels, perceptions are largely driven by disease outbreaks, which can occur at any time and affect any industry!

## The HACCP/Pathogen Reduction Act: Possible implications for market access

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The passage of the HACCP/Pathogen Reduction Act in July 1996 has radically altered the regulation and inspection of meat hygiene in the United States. The legislation was intended to:

- clarify the responsibility of plant management to ensure compliance with sanitation requirements;
- establish enforceable requirements for prompt chilling of carcasses and parts;
- establish interim targets for pathogen reduction and mandate daily microbial testing in slaughter establishments to determine whether targets are being met or remedial measures are necessary; and
- require that all meat and poultry establishments develop, adopt, and implement a system of preventive controls designed to improve the safety of their products, known as HACCP.

Microbiological testing comprises company testing for 'generic' *E. coli*

**Table 2**

United States baseline levels for generic *E. coli* and *Salmonella* proposed as interim targets for meat and poultry establishments

Commodity	<i>E. coli</i> levels (cfu/cm <sup>2</sup> )		<i>Salmonella</i> prevalence* (%)
	lower limit	upper limit	
Hogs	10	10,000	8.7
Fresh pork sausages		NA	NA
Steers / heifers	0	100	1
Cows / bulls	0	100	2.7
Raw ground beef		NA	7.5
Broilers	100	1000	20
Turkeys		NA	NA
Raw ground chicken		NA	44.6
Raw ground turkey		NA	49.9

cfu Colony forming units  
 NA not available  
 \* Prevalence of positive carcasses

and FSIS testing for *Salmonella*.<sup>13</sup> The FSIS has defined targets for major species and products based on national baseline surveys (Table 2). The aim is that within 42 months all establishments will achieve an incidence of contamination below these target levels. One pig per thousand will be tested for generic *E. coli*. Product is deemed out of compliance if any sample exceeds the upper level or if three samples within any 13 consecutive tests exceed the lower level.

At first glance, we see that the new regulations apply most directly to processing plants and have no direct impact at the farm level. In the longer term, and specifically for establishments that are not meeting targets for *Salmonella* with in-plant process controls, the combination of microbial testing and HACCP in plants has the potential to affect buying policies by plants. Studies in Australia showed that *Salmonella* levels in product were largely determined by *Salmonella* levels in pigs supplied to plants.<sup>14</sup> A logical development for plants striving to re-

duce *Salmonella* would be to evaluate *Salmonella* levels in the sources of their hogs. This is now routine in Denmark,<sup>15</sup> and could have dramatic implications for individual producers.

For veterinarians to help producers respond to this problem, sound knowledge about the epidemiology and control of foodborne pathogens in general, and *Salmonella* in particular, will be essential. To this end, the National Pork Producers Council (NPPC) has provided specific funding for research of foodborne pathogens over the last 3 years, and some initial information is now becoming available. In North Carolina, we found that *Toxoplasma* and *Trichinella* were virtually absent from finishing pigs raised in multiple-site, total confinement systems managing the nursery and finishing barns in an all-in-all-out (AIAO) fashion.<sup>16</sup> However, somewhat

unexpectedly, *Salmonella* prevalence tended to be higher in the AIAO systems than in conventional farrow-to-finish operations with continuous-flow finishing barns.<sup>17</sup> This underlines the complexity of *Salmonella* epidemiology and the need for better understanding of how these organisms are spread and maintained on farms.

## Protection and protectionism: International free trade agreements (GATT, NAFTA)

The history of *Trichinella* and United States exports to Europe remind us that, while prohibition of imports based on disease risk is important for protecting consumers, these issues are often seized upon by vested interests within importing countries to reduce competition from imports. Recent disease issues raised by other countries to prevent importation of United States pork or pigs could in some cases be argued

**Table 3**

'Disease' and related barriers to United States pig or pork exports and estimated revenue loss (National Pork Producers Council)

Country	Disease	Requirement	Loss (×\$1,000,000)
South Africa	PRV / PRRS	Freeze 30 days at -25°C	112
Brazil	TGE	—	37
Venezuela	PRRS	—	19-37
Canada	PRV	Transport in sealed trucks to slaughter	18-36
Mexico	PRRS	—	20
Russia	—	Certification costs (annual), testing	not determined
EU	—	Inspection standards	not determined

PRV Pseudorabies  
 PRRS Porcine reproductive and respiratory syndrome  
 TGE Transmissible gastroenteritis

to be more protectionist than protective (Table 3).

The most significant development worldwide was the Uruguay round of General Agreement on Tariffs and Trade (GATT) negotiations and, for United States producers and consumers, the North American Free Trade Agreement (NAFTA). As the successor to GATT, the World Trade Organization was established as a forum for resolution of trade disputes.<sup>18</sup> Specifically within GATT, the Agreement on Sanitary and Phytosanitary (SPS) Measures is designed to prevent import restrictions based on unsubstantiated health concerns. Principal features of the SPS agreement are:

- Nondiscrimination: all countries should be treated the same.
- Maintenance of sovereignty—members retain the right to take measures to protect human, animal, and plant health.
- Aim to harmonize SPS measures based on international standards, guidelines, or recommendations.
- Countries can give human, animal, and plant health priority over trade provided a scientific basis is demonstrated, and can define a level of acceptable risk.
- Use of risk assessment techniques developed by Office Internationale des Epizooties.
- Regionalization—recognition of disease-free regions within countries.

Recent developments linked to the recognition of GATT principles, and which could have benefits for the United States swine industry, include:

- A risk assessment by Agriculture Canada indicating that importation of live United States pigs from pseudorabies-free states poses no danger.
- Challenge in the World Trade Organization of the failure of the European Union to recognize equivalence of United States inspection procedures.
- Changes in Japanese standards of antimicrobial residues (see below).

## Antimicrobial and chemical residues

While microbiological food safety has received high publicity and is viewed as an important problem by professional groups, some surveys indicate that consumers are more concerned about residues of pesticides, chemicals, and antimicrobials.<sup>19</sup> The potential for market-related 'disasters' is as real for residues as for infectious diseases. For example, in the 1980s, the \$960 million Australian beef export industry was seriously threatened when United States authorities detected organochlorine residues above 'maximum residue limits' (MRLs).<sup>20</sup> Because of the high margin of safety resulting from the low levels at which the MRLs were set, there was negligible risk of human health problems. However, there were real consumer concerns that resulted in major problems for international trade.

The problem brought a response that involved Australian federal and state authorities and producer and industry organizations. These groups initiated:

- a tenfold increase of testing (almost 10% of cattle slaughtered),

- traceback to herds where animals had residues above  $\frac{1}{4}$  of the MRLs,
- on-farm investigations that included soil residue analysis,
- quarantine of affected premises or animals,
- banning of sales and recall of existing stocks of DDT, and
- greater restrictions of use of other organochlorines.

This example reinforces the fact that, in order to maintain consumer and market confidence, industries must be prepared to make significant responses to food safety concerns, even when the real human health risks are minimal. Another key feature was that the ability to respond to the problem was dependent on the ability to trace back to herds of origin. It is inevitable that companies entering export markets, and seeking to provide assurances of quality, will seek to develop stronger relations with reliable producers.

In the United States pork industry, the prevalence of violations in sulfonamide tests declined from an unacceptable 7% in 1984 to 0.61% in 1991;<sup>21</sup> in 1995 there was a 0.65% prevalence of violations. While this is some cause for comfort, it should be pointed out that the prevalence of violative organochlorine residues that threatened the Australian beef export industry was 0.42%.

One undeniable fact about residues is that exposure occurs on the farm and producers are primarily responsible for residue violations. Given the ability of the media to inflame issues in the public mind, producers who do not take this issue seriously are doing the industry a disservice. The Pork Quality Assurance (PQA) program of the NPPC is an enormously successful program which now has some 24,000 producers participating. Of these, 17,000 producers (some 40% of national production) are certified at the highest level (Level III). Producers who do not participate in the PQA may find that their options for marketing hogs will decline in the future.

At the international level, the Codex Alimentarius Commission was named as the international reference organization for health and safety under the GATT/SPS agreement, and defines international standards of MRLs for residues. Under the SPS agreement, a nation that adopts a Codex MRLs is seen as meeting its obligations under the SPS. Again, countries are free to adopt more stringent standards than Codex, but these should be justified on a scientific basis related to acceptable risk.

The power of international agreements is reflected in the decision in 1995 by the Japanese government to change its policy of 'zero tolerance' to residues and adopt MRLs for some compounds, largely in acknowledgment of their obligations under the SPS provisions. The Japanese have adopted the Codex MRLs for oxytetracycline residues in muscle, liver, kidney, and fat of swine and the proposed MRLs for chlortetracycline and tetracycline. However these differ from current United States tolerances, being above or below according to the compound (Table 4). Clearly, oxytetracycline residues should not be a problem in exported pork if domestic requirements are met. However, the situation is very different for chlortetracycline, for which United States tolerances greatly exceed Codex MRLs. Currently the Food and Drug Administration (FDA) is reviewing all Codex food standards for acceptance. However, some current United States standards exceed

**Table 4**

Codex, Japanese, and United States Maximum Residue Limits (mg/kg) for oxytetracycline and chlortetracycline

	Muscle	Liver	Kidney	Fat
<b>Oxytetracycline</b>				
Codex	100	300	600	10
Japan	100	300	600	10
United States	100	100	100	100
<b>Chlortetracycline</b>				
Codex	100	300	600	—
United States	1000	2000	4000	200

Codex levels (Table 4). In August 1996, the NPPC announced a call for producers to observe a voluntary 14-day withdrawal of oral tetracycline products if they are selling to a packer that is active in international markets. In Australia, a country that exported to Japan during the 'zero tolerance' era, producers supplying one export plant were required to sign declarations that antimicrobials had not been given to specified batches of pigs, and were paid a premium. Again, this illustrates that achieving quality assurance for the marketplace is a powerful force towards stronger alliances between packers and producers.

## Food safety and quality assurance: What are international industries doing?

Avoiding disease outbreaks and residue violations is one side of the marketing coin with regard to food safety. Formal quality-assurance programs, of much broader scope than the PQA, are already in place in some pork-exporting countries. These programs exist almost entirely to increase consumer and buyer confidence in their product. Predictably, Denmark and the Netherlands, the two leading pork exporters, are leaders in this area.

### The Dutch Integrated Quality Control (IQC) project

In the face of expanding international competition, the Dutch pork industry determined that producing a 'quality product' that could distinguish itself from competing products would help expand its market share.<sup>22</sup> The IQC project was born — a program that required cooperation and joint responsibility between producers, packers, and retailers. The components of the IQC are:

- Standard requirements for pig production including hygiene, drug uses, and origin of the animals.
- Minimal requirements for certification of participants in the production system, including producers, slaughterhouses, veterinarians and feed suppliers.
- Identification and registration of all animals.
- Monitoring of lesions at slaughter, with feedback to producers.
- Serological monitoring of some foodborne agents (*Trichinella*,

*Toxoplasma*).

- Registration of disease outbreaks, mortalities, and drug and vaccine use in a logbook.
- Requirements governing finisher floors, light intensity, pig density, animal welfare (no tethers for sows), and parasite control.
- 12-hour feed withdrawal before slaughter.
- Restriction of antibiotic use (6–8 week withdrawal).
- Hygienic controls for visitors.
- Transportation guidelines.
- Good Veterinary Practice codes for veterinarians.
- Good Management Practice codes for feed companies, including freedom from unwanted substances (drugs, heavy metals, mycotoxins, and *Salmonella*).
- Branded product (IQC logo).

### The Integrated *Salmonella* control program in Danish pork

In 1993, there was an outbreak of human salmonellosis in Denmark, traced to pork, which provided the impetus to establish an integrated *Salmonella* control program. The nationwide control program comprises:

- control of *Salmonella* in feedstuffs,
- surveillance and control in breeding herds,
- surveillance and control in finishing pigs, and
- control measures in abattoirs.<sup>15</sup>

The program is claimed to have reduced *Salmonella* contamination of pork by 50%. Denmark exports some 80% of production, and is recognized as a leader in hog slaughter technology. The combination of low levels of *Salmonella* in Danish pork and the presence of a nationwide *Salmonella* surveillance and control program represents a competitive advantage with respect to quality assurance in the international marketplace.

Clearly, these leading pork-exporting nations are well ahead of the overall United States industry with respect to comprehensive quality assurance programs. The PQA is an important foundation for the development of more comprehensive programs in the United States. Owing to the demographics of the United States industry, it is most likely that such programs will be initiated by individual companies that are competing in the international marketplace, rather than at the wider industry level—industry-wide programs are more easily achieved in smaller countries like the Netherlands and Denmark.

### Consumer and buyer perceptions: Where is the United States now?

The question of how pork is perceived has been asked recently at both the domestic and international levels. As reported in the Pork Chain Quality Audit<sup>21</sup> in which pork retailers ranked consumer perceptions, the concern that pork is not safe ranked eighth among quality concerns. The most significant quality barriers for consumers were:

- lack of familiarity with pork: proper preparation and versatility;

- perceived nutritional deficiencies; and
- inconsistency in product and packaging and meat case display.

A survey of foreign meat traders found that many stated product safety to be the primary reason, ahead of low price, that they purchase United States pork.<sup>23</sup> FSIS inspection was found to instill trust in the minds of foreign customers regarding pork safety.

## Strategies for domestic and international markets

Food safety is currently not perceived as a major barrier to the access of United States pork to the domestic and export markets. However, as stated in 'A Long-Range Plan for the Pork Industry,'<sup>21</sup> food safety issues are critical in terms of the continued marketplace success of pork. Outbreaks of disease and quality assurance will be the key factors determining success.

Disease outbreaks have driven much of the history of meat inspection and regulation. The BSE issue shows clearly that profound and rapid consequences can result from outbreaks, even if the implications for human health are questionable. Obviously, the industry cannot anticipate outbreaks of new or old diseases, but adverse publicity can appear overnight. The industry needs to be equipped with current and extensive knowledge about known foodborne pathogens in the pork production chain, to be able to give science-based responses to media inquiries. Recent information obtained from the National Animal Health Monitoring System (NAHMS)<sup>11</sup> and applied research funded by the NPPC has great value in this contingency. Provision by the NPPC of specific funding for research of foodborne pathogens is an important step toward industry preparedness in the case of outbreaks.

Quality assurance (QA) is the other side of the coin, and takes many forms. Ironically, the traditional FSIS system which has received considerable criticism domestically constitutes a valuable QA feature in export markets. Competition based on QA is already with us in the international marketplace, as evidenced by the Danish and Dutch programs. In the absence of outbreaks, it is difficult to predict how important QA programs will be relative to other quality factors and price. However QA, in one form or another, will be an essential tool for expanding market share. The following strategies, which will affect producers and the veterinarians who advise them, are predictable:

- Mandatory participation in PQA, or a like program, for residue avoidance.
- Ability to trace back problems to producers.
- Reducing numbers of suppliers.
- Strategic alliances throughout the pork chain.

Several of these QA demands are forces in the direction of integration. Unlike the historical precedent of commodity products coordinated through spot markets, the model of Premium Standard Farms has clear advantages with respect to traceback and the ability to control and document the entire production process (a feature of both Dutch and Danish programs). Similarly, Carolina Food Processing in North Carolina obtains the majority of its hogs from a small number of large

producers, again facilitating the implementation of QA measures. Domestic and international demands for quality assurance of food safety can be expected to influence market access for producers in the future. Swine veterinarians need to keep informed about the dynamic landscape of food safety in the United States to enable their clients to adapt to these changes.

## Implications

- Failure to provide quality assurance standards equivalent to our domestic and international competitors could, in the long term, prove more detrimental to market penetration than sporadic outbreaks of foodborne disease.
- Industry-wide efforts to assure product quality are logistically more difficult in the United States than in some smaller, and more cohesive, industries in Europe.
- Quality assurance initiatives will be customer driven and will be directed by the packing industry.
- Our traditional commodity approach through spot markets is the antithesis of a program designed to assure quality.
- Market demands for quality assurance, particularly internationally, may become a powerful force towards stronger packer-producer alliances, vertical integration, and marketing branded products.

## Acknowledgments

I wish to thank Beth Lautner and the National Pork Producers Council for assistance in compiling and reviewing the manuscript.

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