Control of public health hazards in pork – current status of knowledge and future challenges.

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Abstract

The range of public health hazards that may occur in pork is very broad including both microbiological pathogens as well as chemical substances. Major international incidents recently highlighted the importance of managing risk at an international level. Control programmes targeted at selected pathogens have been introduced in a significant number of countries over the past years. Most notably, the control of Salmonella along the pork production chain represents a substantial effort of pork producers and veterinary services to reduce public health risk. But the control of “traditional” hazards such as Trichinella also still require substantial resources, while new hazards such as bacteria with resistance against antimicrobials also demand increasing attention. As funds available for risk management are limited, priorities need to be set. To set the right priorities will be a key challenge for the effective and efficient control of pork-related hazards in increasingly global food systems. Also, there is currently a lack of intervention strategies with proven effectiveness against a number of major pork-borne pathogens such as Campylobacter. Control of such hazards can only progress if technically and economically feasible strategies are available. An additional challenge for pork industries but also governments is risk communication, specifically the prevention of negative market impact by unsubstantiated risks perceived by consumers.

Introduction

In December 2008, a major incident related to pork contaminated with dioxin caused major disruption of trade. The international recall that followed is thought to have affected pork supplies in at least 23 countries. The economic consequences of this incident included a 200 Mio. € tax-payer-funded compensation package for the Irish pork industry (Kennedy et al., 2009). This is not the first case illustrating the increasingly international and sometimes global nature of pork supply chains and the implications of food safety scares in such systems. Similarly, multi-country outbreaks of bacterial food poisoning traced back to pork are a reality in today’s complex international markets (Bruun et al., 2009). In order to maintain consumer confidence, health hazards related to pork need to be controlled and minimised as much as possible.

Control of pork-borne health hazards may require a number of activities such as monitoring/surveillance, interventions and inspections/audits. It is now generally accepted that activities should focus on the food chain as a whole and not just the safety of the end product. International standards for fresh meat have to be followed if pork is traded internationally. Principles outlined by the Codex Alimentarius Commission (CAC) are applicable (see www.codexalimentarius.net). Similar to other international trade standards, the CAC’s Code of Hygienic Practice for Meat (2005) is based on the concept of risk analysis.

Pork as a risk to public health

The goal of zoonotic pathogen control in pigs and pork is to improve public health. A systematic collation of data on pork as a cause of human food-borne disease is currently lacking. To address this gap, the World Health Organisation (WHO) is currently running a major project to estimate the global burden of food-borne disease. One aim of this project is to provide countries with a simple tool to estimate their own level of food-borne disease and to set priorities for prevention and intervention. A global report and an atlas on food-borne diseases are expected to be available within the next three years (for more details see www.who.int).
In the USA, data on food-borne infections are collated by FoodNet which is run by the Centre for Disease Control (CDC; [www.cdc.gov](http://www.cdc.gov)). Preliminary data for 2008 indicate that the case incidence was highest for *Salmonella*, followed by *Campylobacter*. Similarly for Europe, according to data collated by the European Food Safety Agency (EFSA; [www.efsa.europa.eu](http://www.efsa.europa.eu)) for the year 2007, *Campylobacter* is currently responsible for the largest number of cases of food poisoning, followed by *Salmonella*. Although most cases for both pathogens were linked to other food, pork is an important source of both *Salmonella* and *Campylobacter* exposure. On average, 1% of fresh pork tested positive for *Salmonella*, but the value was >7% in several European Union (EU) Member States. For *Campylobacter*, data are less systematically collected. Current results suggest that the level of contamination of pork at retail is <1.1% (Anonymous, 2009).

There is an ongoing, general debate on the risk of non-human use of antimicrobials in livestock production. Participants of a WHO expert meeting published a call for a ban of non-human use of antimicrobial substances if they are classified as critically important for human treatment (Collignon et al., 2009). Substances affected by such an approach would include third- and fourth-generation cephalosporins, fluoroquinolones and macrolides. This publication has triggered strong reactions in several countries indicating that opinions on this matter remain polarised.

**Current control of pork-borne hazards**

Controls can either be of a general nature or they can be targeted at specific hazards. In the latter category, *Salmonella* and *Campylobacter* currently receive most attention. Monitoring of *Salmonella* along the pork production chain has been introduced throughout the EU and in other major pork producing countries. Monitoring is based on serology and follow-up bacteriological testing. The level of infection varies considerably between countries (Anonymous, 2009). Also, the strategies used to respond to positive testing results vary. The options include biosecurity measures, change in feeding regimes and feed composition as well as use of vaccines (Boyen et al., 2008). The EU has yet to communicate a *Salmonella* control target for pork but has already set one for poultry. Regarding *Campylobacter*, monitoring has not yet been systematically introduced throughout the pork chain and information on suitable intervention strategies — other than freezing of the meat — are scarce.

In addition to pathogen-specific controls, there are controls implemented for less frequently found hazards, for example *Trichinella*. While these controls require substantial resources, their health benefit is debated. The use of risk-based surveillance has been proposed as an attractive approach to set priorities for surveillance efforts. A risk-based surveillance proposal for *Trichinella* submitted by Denmark has recently been accepted by the EU (Alban et al., 2008). Another expensive and — due to a low frequency of positive samples — inefficient control is residue testing of pork (and other meat). Once again, risk-based sampling designs could dramatically improve the efficiency as was shown for tetracycline in veal (Presi et al., 2008).

Monitoring is also in place to assess the level of antimicrobial resistance in bacteria found in pork. However, these data are currently not formally used for decision making as no action levels have been defined. No substances have yet been withdrawn from use for pigs on the grounds of risk of resistance and implications for public health. However, the ongoing debate on non-human use of antimicrobials indicates that better evidence will be needed to justify the safe use of antimicrobials in livestock.

General food safety measures such as meat inspection, traceability requirements and good hygiene practice of food business operators are also implemented in pork production chains. These general control measures are compulsory for pork that is traded internationally. Current meat inspection procedures have come under increasing scrutiny regarding their effectiveness to identify zoonotic pathogens. Leps & Fries (2008), for example, documented that incision of the heart was not justifiable on public health grounds. Countries are therefore increasingly moving towards risk-based approaches in meat inspection. Such
systems are considering information provided by the primary producer and past inspection results for the risk classification of carcasses.

Future challenges

Limited resources available for the control of food-borne hazards will continue to be a major challenge for industries and governments. There is an increasing demand for documentation and therefore surveillance of hazards in pork for both domestic and international trade. Setting priorities is therefore critical. Risk-based priority setting is becoming generally accepted as a transparent and objective approach. However, economical assessments of the consequences of food-borne pathogens and the costs of control activities are often not systematically considered. Tools are needed to design economically optimal controls at industry and farm level. Surveillance and intervention costs are often considered separately but not analysed in context. Risk and economical analyses should evolve into an integrated framework.

We do not yet have effective intervention strategies for all hazards that are currently occurring in pork. Interventions that are independent of antimicrobial treatment are clearly preferred, particularly when considering a scenario where substances that are currently available may be withdrawn from use in pigs.

Pork production and trade patterns have become increasingly complex and often cross country borders. While international trade offers attractive opportunities for businesses, there are also risks involved. Risk analysis is one of the key tools used for trade decisions. Nevertheless, trade disruption does occur and food security is not always assured. International food risk management requires reliable early warning systems, established communication channels and effective recall mechanisms. Risk communication is also essential to minimise unwarranted consumer reactions.

As a consequence of increasing consumer demand, global pork production keeps growing. New production systems are emerging both at the intensive and extensive end of the range of husbandry systems. On the one hand, pigs are kept in intensive systems and new technologies such as cloning may lead to increased productivity. At the other end of the range, small backyard units in urban and peri-urban settings are increasingly common, leading to food and environmental hygiene problems.

In addition to new technologies and production systems, new pathogens also keep emerging in pigs. Some may be food-borne but others are not. The example of the new influenza A H1N1 virus demonstrated that risk communication is essential and yet very challenging. Meticillin-resistant *Staphylococcus aureus* (MRSA) ST398 emerging in pigs also illustrated the need to provide solid evidence that pork and pork products are safe. Emerging pathogens can be extremely trade disruptive and markets may be permanently lost.

The ultimate challenge for the future would be the creation of specific-zoonoses-free (SZF) pig units. It should be possible to produce SZF pigs, but they then need to be maintained free by strict biosecurity measures. While the risk of airborne introduction can be considered limited, insects, vermin and people can bring hazards into closed units. Also, animal-welfare friendly husbandry systems such as outdoor housing/access are a challenge to biosecurity. However, SZF could be economically attractive as interventions against zoonoses would no longer be required and the use of antimicrobials is likely to be reduced, but a market niche for SZF pork would have to be developed. Currently, supermarket chains do not appear to be sufficiently concerned about food-borne infections to pay a premium price for SZF pork.

References


