Fuente: Salinpork 2001.

Fecha: 5/ 09/ 2001

Pre-harvest Food Safety as Integral Part of Quality Assurance Systems in the Pork Chain from "Stable to Table"

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The changing framework of the global food system: The liberalization of the global trade with food, and the fact that the consumers in the industrialized countries are more and more demanding food to be not only economical, but also healthy, tasty, and safe, while at the same time respecting animal welfare and the environment, are the two major determinants of rather drastic changes occurring in agriculture throughout the world. The current quantity-oriented food production (agricultural bulk-commodity supply of agricultural raw products into the food production chain) that guarantees the nutrient supply for a nation is changing into an international quality-oriented food system (vertical supply chains for the production of identity preserved food). The main driver of this development is without doubt the never-ending chain of food safety break-downs: *Salmonella* Enteritidis in eggs, BSE in the UK, E. coli O157:H7, the emergence of *Salmonella* Typhimurium DT104, the dioxin scandal in Belgium, and the BSE-scares in several continental European countries, especially in Germany. These events led to an increasing demand for transparency and traceability of the entire food production chain, including the agricultural primary production.

In contrast to the quantity-oriented production of an anonymous agricultural raw product that is often subsidized and where producers can always sell everything they produce, the quality-oriented food supply is customer-driven and products are traceable back to the farms of origin and they are only sellable, if there is a market. The main impact of this development on pork producers is that increasing productivity and

optimizing the herd health while decreasing costs is no longer the only guarantor for success in the pork industry, but meeting the specifications of the targeted market segment is of growing importance for the economic success and stability of swine operations.

All this means that the agricultural supply for food chains is facing remarkable changes in the years to come, to which vertically integrated food production systems can, at least theoretically, adapt quite easily. This adaptation, however, is incomparably more difficult for the independent farmer, since there is no structure for standardizing the production procedures on diversified independent farms and for linking the independent farmer with the markets for the final product. Thus, the gulf between the highly effective, but socially stigmatized vertical integrators on the one hand and the nostalgically desired, but inefficient "family farms" on the other is widening and the capacity of the independent farmer to remain competitive is diminishing.

For several reasons, society does not like the idea of letting the family farmer "die" and "factory farming" take over, although high quality (branded) and yet inexpensive food is widely preferred. Thus, there is an urgent need to develop means by which the independent farming community can adopt standardized good manufacturing production procedures and gain market access that keeps them "alive" and competitive without constant subsidies. The major tools for adopting standardized production procedures at farm level that address food safety, high quality, animal well being and environmental stewardship is the implementation of on-farm measures based on the principles of HACCP (Hazard Analysis Critical Control Points) and of quality management and certification programs such as ISO 9000:2000, which embrace as a core element the concept of pre-harvest food safety.

The concept of pre-harvest food safety: In countries that have implemented a consistent mandatory meat inspection, this classical "harvest" food safety procedure and the more and more stringent rules for the "post-harvest" food safety measures improving the hygiene standards during slaughter, meat processing, storage and distribution have led to a remarkable decline of meat-related food-borne diseases in man. However, although meat inspection and food hygiene in slaughterhouses and the following production stages have been regarded as sufficient to guarantee safe meat over almost 100 years, new approaches to food safety and meat quality are becoming necessary. BSE, E. coli O157:H7, ongoing Salmonella outbreaks and dioxin scandals have led to an increasing distrust in the existing system of guaranteeing the supply of safe food, which has so far mainly relied on governmental single-point inspections at slaughter and/or during processing.

The majority of today's food safety concerns, however, have their origin in the production stages prior to slaughter and processing, the "pre-harvest" stage, i.e. the agricultural primary production. Examples for these pre-harvest food safety issues, which stem from non-defined and non-standardized agricultural production procedures, are: latent infections such as E. coli O157:H7 in cattle, Salmonella in pigs, poultry and cattle, feed contamination with dioxin or TSE prions. Furthermore, the use of antimicrobials in food animals is an emerging concern, which additionally draws the attention of the public to the production practices in livestock production.

All this means that there is an urgent need to develop pre-harvest food safety procedures that are to be added to the existing harvest and post-harvest food safety and food hygiene measures. In the context of these considerations, the necessary activities for pre-harvest food safety can be defined as: "the complex of measures that needs to be taken at farm level (farm supply and on-farm procedures) that aim at preventing and/or minimizing the amount of food-borne health risks to humans carried into the food chain via animals and animal products".

In the case of slaughter pigs, these "pre-harvest risks" are such as chemical residues, resistant bacteria or bacterial genes, zoonotic *Salmonella* spp., *Trichinella spiralis*, *Toxoplasma gondii*, *Campylobacter coli* and *Yersinia enterocolitica*, as well as foreign bodies (e.g. broken needles).

How to incorporate pre-harvest food safety into complex quality assurance systems: The need to improve the production standards of food animal production as response to the consumers' and the society's expectations has been realized and addressed for at least 10 years in most countries with an developed pork production, especially in countries that export pork (Denmark, The Netherlands, Belgium, the USA and Canada). These countries have, in slightly different ways, developed standards for swine production that are driven by the producer associations (the Canadian Pork Quality Assurance System, and the PQA System of the U.S. National Pork Producer Council), or by industry associations (the Quality Assurance System of the UK Meat and Livestock Council, and the Dutch Produktschapt voor Vee and Vlees with its renowned IKB-program = Integrale Keten Beheersing), or with laws or ordinances issued by governments that set the basic standards as in the European Union with the "Zoonosis Directive", or in Germany with the "Schweinehaltungshygiene-Verordnung".

There is no doubt that these systems have had a positive impact on the overall knowledge of producers about good management practices at farm level, and they have contributed to e.g. the steady decrease of drug residues in meat e.g. in the USA. However, these systems are still mainly bulk-

commodity systems, since they address just the commodity in question such as pork, beef, milk or eggs rather than specific types of these food commodities with clear declarations of their specifics. The reason for this is that most of these systems are built on general standards, are "only" educational, are not regularly audited, and are not enforceable on every farm. Thus, they did not prevent the accelerating diminishing of the consumers' trust in food. Even if 99% of all farms supplying a type of food comply with such GMP-like general standards, 1% end even less non-compliance results in further distrust in the current bulk-commodity setting.
Therefore, more and more producers and producer groups look for developing and implementing "market-driven" quality management and certification systems. In the following, the principles of this approach using the example of the new-generation cooperative "Minnesota Certified Pork" (MNCEP) are described
Taking the described changes in the agricultural and food supply world into account has led to the establishment of a so-called new type cooperative called "Minnesota Certified Pork" (MNCEP). This cooperative is founded on the principles of implementing and certifying market-driven high quality and food safety standards on member farms to supply certain market segments with differentiable defined pork products. The cooperative is open to any progressive pork producer that is willing to comply with the MNCEP standards. MNCEP has, with the support of faculty members, staff and students of the University of Minnesota, developed its **MNCEP Quality Handbook**. It describes the **S**tandard **O**perating **P**rocedures (**SOP's**) for the daily activities in the following areas: **Best Production Procedures** (animal care, breeding, farrowing, feeding, sanitation etc., etc.), **Food Safety** (prudent use of antimicrobials, residue avoidance, on-farm salmonella reduction, trichina- and toxoplasma-free production procedures, and needle avoidance measures), **Environmental Stewardship and Community Relations** (MPCA permit, Manure management plan, manure storage management, and odor reduction), **Animal Well Being** (facilities and animal environment, animal husbandry and care, handling, mixing, moving and transporting animals). The Quality Handbook also describes what and how to record the activities **(Logbooks)** that have an impact on the compliance with the MNCEP quality standards.
The compliance with these quality and safety standards is achieved by:

1) Once a month: internal audits of every single MNCEP farm that help the

   MNCEP members to implement the SOP's outlined in the MNCEP Quality Handbook and that produce records on th4e basis of audit check lists to prove the compliance with the SOP's. In case of non-

compliance, they help the MNCEP members to implement the necessary corrective measures, and

record the resulting compliance during a follow-up visit;

2) Once a year a third-party certification of the compliance of the entire operative with the rules of the MNCEP Quality Handbook by the State of Minnesota (Department of Agriculture, Board of Animal Health), using the state seal with the addition "Minnesota Certified" (MinnCERT).

The internal audits and the third-party certification by the State of Minnesota follow the concept of ISO 9000 : 2000.

The majority of the described SOP's are **recommendations** that help standardize the production processes on MNCEP farms and improve the overall efficiency on the farms that follow the Quality Handbook. However, those SOP's that are necessary to meet defined demands of a targeted market segment are **requirements** that are subject of the internal audits and the third-party certification. The 8 defined market demands that were selected for the initial phase of implementing the MNCEP standards on the first MNCEP member farms are:

1) compliance with high-standard animal well being rules,
2) no sub-therapeutic use of antimicrobials,
3) *Salmonella* monitoring and risk reduction
4) *Trichinella*-free production procedures,
5) *Toxoplasma*-free production procedures,
6) needle-avoidance measures
7) no use of rendered animal by-products, and
8) "Minnesota grown" (= born and raised in Minnesota)

On January 29, 2001, 5 Minnesota producers (3000 sows altogether, sow herds ranging from 100 to 2000 sows) were granted the "MinnCERT certificate" signed by the Minnesota Commissioner of Agriculture, certifying the compliance with the criteria listed above.
Since then, MNCEP has had numerous calls from and meetings with several market segments (i.e. retail chains) that are interested in MNCEP pork as their supply.
This proves that there is the potential that this quality-oriented approach will enable pork producers to capture more value out of the pork chain, and that it is a potential solution for keeping independent pork producers in business at a time of increasing industry consolidation.

In February 1, 2001, the Department of Agriculture of the State of Minnesota has submitted to the Minnesota Legislature a draft

appropriations bill to ask for state funding for developing "Minnesota Certified" (MinnCERT) as a state/university program for certifying high quality and food safety procedures in any agricultural production system supplying raw material into the food production chain.

***Salmonella* Reduction as a "forerunner" and model for incorporating pre-harvest food safety into on-farm quality assurance systems:** There is no doubt that *Salmonella*, although not really being the most important threat to human health, is the food-borne issue that "enjoys" the highest public recognition. Pork is generally recognized as, following poultry meat and eggs, the second important source of human salmonelloses. The current literature on the herd/flock prevalence of *Salmonella* in livestock and the frequency of salmonella-contaminated meat allows the following rough estimate: poultry flocks can be salmonella-positive up to 90%, poultry meat can be positive up to 60%; pig herds can be positive up to 70%, pork up to 5%; cattle herds can be positive up to 30%, beef up to 1% (for this estimate: a herd or flock is regarded positive, if one ore more animals per flock/herd are positive).

The successful *Salmonella* control programs for livestock and feed in Sweden, Finland and Norway during the past three to four decades (herd/flock prevalence lower than 1%!), and the National *Salmonella* Control Program in the Danish pork industry, create an international "market pressure" that even influences domestic markets via increasing public discussion of food safety concerns. The successful reduction of *Salmonella* in Pork, even just the implementation of any control program, is a huge opportunity for improving both the consumers' trust in pork and the market accessibility, especially in the international market.

In the beginning of the research into the occurrence of zoonotic *Salmonella spp*. in swine (which is different from the porcine salmonellosis caused by *Salmonella Choleraesuis*!), there was the expectation to identify a general epidemiology of the *Salmonella* infection in swine. However, the idea of identifying a "simple" infection pattern, which is common for zoonotic *Salmonella spp*. in swine herds has faded away: in-depth investigations revealed that the occurrence of the zoonotic *Salmonella spp*. is much more dynamic than previously thought. The prevalence patterns are changing from farm to farm, from shipment to shipment and within a farm even over time.

There is growing knowledge on the role of animal movement, environmental contamination, the huge variety of sources for *Salmonella* infections of pig herds, the possible reservoirs and the daily working procedures for introducing *Salmonella* onto a swine farm and into a swine herd as well as for the perpetuation of the infection-contamination-infection cycle on farms that once became contaminated.

There is no “silver bullet” that solves the problem of *Salmonella* in pork, but there are many encouraging results on what contributes to a reasonable on-farm *Salmonella* reduction, which develops into a set of measures that together have the potential to permanently reduce the *Salmonella* burden of swine farms. These measures are such as:

- applying feeding and nutrition methods that reduce the multiplication of *Salmonella* in swine; e.g. using feed from feed mills with Good Manufacturing Practice (GMP) that focuses on permanently reducing the risk of *Salmonella* contamination of the feed),
- cleaning and disinfection (e.g. targeted cleaning and removal of potential reservoirs such as dust prior to bringing new stock into a barn, and daily disposal of spilled feed),
- targeted intensification of external and internal biosecurity measures (e.g. limited traffic of trucks and personnel, changing of clothes and boots even between barns, rodent control etc.),
- “salmonella-reducing” production procedures (e.g. one-way flow of personnel and animals, separation of swine herd from other livestock species etc.), and
- potentially competitive exclusion flora, vaccination as well as probiotics and feed additives that reduce the multiplication of *Salmonella* such as organic acids.

It is necessary to develop rapid and economic methods to identify farm-specific *Salmonella* patterns to be able to choose from the above list of potential *Salmonella* reduction measures those that apply for the farm in question. In other words, every farm needs a “customized” *Salmonella* reduction plan dependent on the type of operation, the daily working procedures and the actual sources of introducing and perpetuating *Salmonella*.

It seems to be important to emphasize:

1) *Salmonella* in pork is NOT a new or emerging problem in the pork industry that is due to wrong-doing, but rather an opportunity for adopting a higher level of safety and quality standards that we nowadays can “afford” to pursue.

2) A salmonella-positive pig or herd does NOT mean salmonella-adulterated pork per se. However, salmonella-positive pigs sent to slaughter lead to an increased risk of *Salmonella* contamination of edible tissue from salmonella-positive gut contents and tonsils during slaughter and processing procedures.

3) The goal of any *Salmonella* control program should NOT be the eradication of *Salmonella*, but the continuous reduction toward zero of the risk of carrying

Salmonella into the food chain via infected and/or contaminated slaughter animals.

Unlike the control programs for hog cholera and pseudorabies that have resulted in the eradication of the two diseases, on-farm *Salmonella* control programs are likely to become part of permanent quality and safety assurance programs at farm level that help producers to improve the marketability of their products.

The next paper presented by Dr. Peter Bahnson, Professor at the University of Illinois, a colleague and friend of mine, who organized together with me the "3rd International Symposium on the Epidemiology and Control of Salmonella in Pork" in Washington, D.C., in 1999, is exploring: "Salmonella Epidemiology and Control: Questions answered and questions remaining".