Risk management of *Salmonella* in pig fattening farms based on HACCP

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Summary: To gain insight in the practical feasibility and effectiveness of using a HACCP-like framework to control *Salmonella* on pig fattening farms a study was carried out. In this paper the risk evaluation technique used for the study is explained. The first experiences show that it appears possible to determine the serious risks and Critical Control Points for *Salmonella* introduction and transmission on fattening farms by means of an HACCP-like framework. Further research is carried out.

Keywords: food safety, risk-analysis

Introduction: Food safety has the increasing interest from consumers and policy makers. As a control system for food safety, the HACCP system (Hazard Analysis of Critical Control Points) is widely used in the food processing industry. In the Netherlands the Dutch Product Board for Livestock and Meat is now preparing a national Control Program on *Salmonella*, covering the pork and pig producing and processing chain. On farm level, systematic and structural control of food safety is not yet very common. The aim of this study is to gain insight in the practical feasibility and effectiveness of using an HACCP-like framework to control *Salmonella* on pig fattening farms.

Material and Methods: The study consists of two parts:

1) *development of a HACCP-like system for minimising risk of introduction and transmission of* Salmonella *on pig fattening farms* (period March-August 2001)

By means of risk analysis, potential hazards are identified and Critical Control Points (CCP's) are determined. For the purpose of this study CCP's are points in the flow diagram of the farm, which are seriously influencing *Salmonella* introduction and transmission on pig fattening farms. For each CCP, critical limits are specified and validated as well as the surveillance mode and the corrective actions if CCP's exceed their limits. This part was carried out as a literature and desk study, completed by expert knowledge.

2) field test on feasibility and effectiveness (period September 2001-September 2002)
On three pig fattening farms the developed HACCP-like system for decreasing the risk of introduction and transmission of *Salmonella* will be tested for practical feasibility and effectiveness.

Results and discussion: To identify potential hazards and CCP's hazard analysis should be carried out. Hazard analysis includes hazard identification and hazard characterisation. With a systematic review of an operation system, processes can be identified where significant hazards may occur. By means of a flow diagram and on-site maps potential hazards can be identified and analysed in a structured way. However the analysis method is not yet assessed and several approaches are possible:

Approach 1: Work out a flow diagram of all farm processes in detail and assess CCP's (after Stärk, 1999)

Approach 2: Identify farm characteristics and supply and removal processes on a high abstraction level; evaluate them with respect to transmission and contamination risks and analyse by means of a CCP decision tree which parts might contain CCP's. These parts then are analysed in detail and specific CCP's are assessed.

Approach 3: Assess characteristics of a *Salmonella* infection including introduction and transmission routes and further analyse these routes on critical control points in farm processes (after Vorst, 1997).

A basic assumption in our study is that a limited amount of most relevant CCP's is assessed. More common items, hazards which could not be described to one part of the process but covers more processes are laid down in a list of preventive control measures (attention points). Examples are a hygiene schedule and rodent control.

By implementing the first approach where all aspects of the process are written in detail, one takes the risks not being able to distinguish major from minor points. Approach 2 distinguishes majors from minors in an early stage but carries the risk that certain detailed measurements are not recognised as a CCP or as a general measurement (filtering of CCP's and other measurements takes place at a high abstraction level). Farm processes are efficiently analysed from the pathogen point of view (transmission routes) by implementing approach 3. Possible disadvantage of this way of hazard identification is that certain parts of the operation processes are not identified as significant risk when it actually should have been. In this study the second approach is carried out for the above mentioned reasons. This approach is demonstrated in table 1 and table 2. A distinction has been made in hazards

related to farm environment (table 1) and hazards related to supply and removal processes (table 2).

Table 1 Risks from farm environment and farm organisation

			Environment (including domesticated pets, rodents, insects and wild birds.	Farm lay-out	Room design	Management
Introduction	**Contamination**	**Pen**	X			X
		Room	X			X
		House	X			X
		Farm	X			X
	Infection of animals	**Individual**	X			X
		Pen	X			X
		Room	X			X
		House	X			X
		Farm	X			X
Transmission	**Contamination**	**Pen**	X	X		X
		Room	X	X		X
		House	X	X		X
		Farm	X	X		X
	Infection of animals	**Individual**	X	X	X	X
		Pen	X	X	X	X
		Room	X	X	X	X
		House	X	X		X
		Farm	X	X		X

Table 2 Risks by supply and removal processes

			Water	Feed	Piglet	Materials/Tools	Visitors	Manure	Rubbish/litter	Cadaver	Porkers
Introduction	**Contamination**	**Pen**	X	X	X	X	X				
		Compartment	X	X	X	X	X				
		House	X	X	X	X	X				
		Farm	X	X	X	X	X				
	Infection of animals	**Individual**	X	X	X	X	X				
		Pen	X	X	X	X	X				
		Compartment	X	X	X	X	X				
		House	X	X	X	X	X				
		Farm	X	X	X	X	X				
Transmission	**Contamination**	**Pen**	X	X	X	X	X	X	X	X	X
		Compartment	X		X	X	X	X	X	X	X
		House	X		X	X	X	X	X	X	X
		Farm	X		X	X	X	X	X	X	X
	Infection of animals	**Individual**	X	X	X	X	X	X	X	X	X
		Pen	X	X	X	X	X	X	X	X	X
		Compartment	X		X	X	X	X	X	X	X
		House	X			X	X				X
		Farm	X			X	X				X

In the hazard analysis introduction and transmission of *Salmonella* are distinguished. Within introduction and transmission subdivision is made of contamination of housing equipment/materials and direct infection of animals. An example from table 2 is bringing in purchased piglets, which mainly influences the introduction of *Salmonella* on farms. Purchased piglets may contaminate the things they touch, thus the whole farm could be contaminated (introduction; contamination). By means of direct contact with purchased piglets with a *Salmonella* infection, penmates or roommates could become infected (introduction; infection of animals). A whole building could become infected when farm piglets already on the farm have contact with the incoming piglets (introduction; infection of animals).

Transmission of *Salmonella* may take place when with piglets with a *Salmonella* infection contaminates the pens (transmission; contamination) or when the purchased piglets have direct contact with the pen- or roommates (transmission; infection of animals). Transmission takes place when purchased piglet with a *Salmonella* infection are moved to other rooms, due to this the whole building or farm could be contaminated (transmission; contamination) and pigs in the rooms might become infected (transmission; infection).
By consistently carrying out this approach overall insight is gained in risks of introduction and transmission of *Salmonella* within the most important operation processes. At this abstraction level risk significance can be evaluated, and it can be determined whether a hazard should be controlled by CCP's or by other measurements.
To label the hazard as "serious risk", the chance and severity of all potential hazards have to be determined. To assess the chance and severity knowledge should be available, but always seems to be debatable. Therefore, any judgement on the assessment of the severity of the hazards should made. The final determination of CCP's is facilitated by application of the decision tree to serious hazards (Codex Alimentarius by the FAO/WHO Codex Alimentarius Commission, 1993). It should be noted that the decision tree doesn't give definite guidelines for assessment of a CCP.
These parts of the process are worked out in detailed process steps; a risk evaluation is carried out.
In this study, CCP's to be worked out in detail include: entrance control of water and water distribution; entrance control of feed, feed control and feeding process; entrance control of piglets and entrance control of materials, equipment and straw and saw dust if possible. In addition, several general control measurements related to Salmonella will be determined. Finally, process parts to be changed for food safety reasons will be identified.

Conclusion: So far it seems that the hazard analysis and determination of CCP's for *Salmonella* introduction and transmission on fattening farms can be carried out theoretically by means of an HACCP-like framework. Further research is carried out.
The results of the first phase of this study will be presented at the Salinporc congress in September (poster presentation).

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