Food Safety and Control programs in the Dutch Pork Production Chain

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ABSTRACT

In the Dutch pork production sector a new certification system with four levels is in development: Animal Safety Index. Each level has requirements in the area of contact structure, on-farm animal health care and animal welfare. One of the advantages of such a system is a better control of food-borne risks for human health, like *Salmonella*. To evaluate the technical and economic effects of requirements in a stage of the pork production chain, we developed a simulation model. To motivate the primary stages to fulfil the necessary requirements to reduce the prevalence of *Salmonella*, a new system of price differentiation is analysed.

Keywords: Pork production, Certification of pig farms, Salmonella control

INTRODUCTION

The past decades there has been an increasing interest for food safety. In Europe several events contributed to stricter regulations and consumer distrust (Verbeke et al, 1999). As to pork these are, for instance, the outbreak of Classical Swine Fever in the Netherlands, the Danish outbreak of food-borne Salmonellosis and the dioxin scraps in animal feed and meat in Belgium. The most prominent events are those that can influence human health, also because of the high societal costs involved. To control food-borne risks and to increase and maintain consumer confidence, it is essential to focus on the whole production chain from breeder to consumer. The attention in the different stages is dependent on the type of risk. To reduce the prevalence of Salmonella, for example, the primary stages should focus on hygiene and other (management) preventive measures and the processing stages on avoidance of cross contamination.

Important criteria for consumers to buy a product are product quality, reputation, price, freshness and guarantee (Steenkamp, 1997), most of which are interwoven. Pork with a quality label received significantly more positive quality perceptions, lower perceived risk and higher commitment (Van Trijp, 1996). Besides the sociological and ethical reasons, there are economic reasons for dealing with food-borne infections like salmonellosis. In Europe health care costs due to Salmonella infections are estimated at between 1.6 and 8.1 billion Euros (Oberender and Heissel, 1999). In the US, the estimated total costs due to human salmonellosis (medical and loss of productivity) in 1998 were around $ 2.3 billion (Frenzer et al., 1999).

In the production of agriproducts, like pork, natural fluctuation and uncertainty are inevitable. But with a better knowledge of the processes and good information flow up- and downstream, uncertainty can be reduced and/or controlled. A sector can choose between three generic strategies: cost leadership and differentiation on a broad target and focus on cost or differentiation (Porter, 1985). Co-operation between stages by information exchange results in a better fit of supply and demand, so the costs in the production chain will reduce, which will strengthen the position in the market.

The solution to the salmonella problem in pork is actually a focus on differentiation. As a basis to solve the problem, the current situation and practice as to food-borne risks have to be known. The occurrence of salmonellosis in humans seems to follow the presence of Salmonella in farm animals (Van Pelt et al., 1998). Therefore, an early warning system is an obvious strategy to improve the current situation by faster detection of increased risks. The objective of such activities is not only to assure food safety, but also to achieve higher levels of service, innovation and quality, substantial savings in costs and improved market position.

In this paper, the current developments with respect to quality of pork and the pork production chain in the Netherlands are outlined and a computer simulation model for Salmonella control, in which different scenarios can be analysed and evaluated, is presented. Simulation models are useful tools to determine critical elements, to evaluate proposed solutions and to synthesise new alternatives.

DEVELOPMENTS IN THE PIG SECTOR; THE ANIMAL SAFETY INDEX

In the Netherlands, the pork sector is developing a certification system to improve the quality of the whole chain, called "Column Certification" (Skovar, 1999). One of the first modules is the Animal Safety Index (ASI) for the primary stages (Bokma-Bakker and Vesseur, 1999). The ASI is an animal health and welfare index, which distinguishes three areas: contact structure, on-farm animal health care and animal welfare. The index includes four levels and each level has its own requirements in each area. Level 4 is the strictest. Because the system is in development, only the first three levels can be defined at the moment. Level 1 is mainly fixed by law with some additional requirements. The underlying idea is that a higher ASI level corresponds with a high product quality and a lower probability of problems with food-borne diseases such as Salmonella-infections.

The current situation is analysed by a questionnaire involving 104 pig farms in the Netherlands. This is an ongoing study. Preliminary results have shown that almost none of the farms can meet all requirements of an ASI level. The percentages of farms that meet each requirement are given in table 1. To motivate the farms to participate in the ASI and because of different (high) investments for each area, it is possible to obtain separate certificates for each area. In a pilotstudy, the feasibility of reaching higher levels within several years is also investigated.

Table 1: Some major requirements per ASI level and the percentages of farms in the field test that fulfil that requirement (: cleaning and disinfecting, **: not possible yet) (Bokma-Bakker and Mul, 1999)*

Requirement level 1	%	Extra requirement level 2	%	Extra requirement level 3	%
Contact Structure					
Hygiene corridor	93	Hygiene corr. only access	65	Only certified service people	**
Visitor logbook	94	Strict separation 'clean' and 'dirty' area	37	Small destruction material collected once a week	81
C&D for trucks *	64				
One address / truckload	100	Separate barn for gilts	23	Owner AI	74
Rodent control program	63	All-in all-out per section	62	One supplier piglets	81
Information supplied pigs	60	Professional rodent control	29	Group housing sows	15
On-farm Animal Health Care					
Integrated Quality Control	95	Program for curative and preventive treatment	33	No antibiotics in feed	8
Presence of sick bay	73			Maximum of Cu and Zn	60
Mange eradication program	21	Certified mange free	16	Certified APP free	**
Certified Aujeszky-free	98	Certified AR free	14	Salmonella control program	**
Animal Welfare					
No binding of sows	66	Specified distraction materials	6	No structural ear-biting	79
Castration piglets max 28 d	66			Escape possibilities during order fighting	21
Daily inspection of animals	97	Illumination at least 40 lux	64		

One of the typical results is that, although 93% of the cases do have a hygiene corridor, only in 58% farmers use it consequently. The presence of a requirement (i.e. in this case the hygiene corridor) does not guarantee the expected results because of inconsequent use of the facilities. Another typical finding relates to the information exchange in the chain. To respond effectively to risks related to diseases or infections, farmers have to have some veterinary background information of the animals they purchase. Only in 60% of the cases, the buyer gets written information that comes with the animals purchased.

The crossbar for each ASI level will increase over time, so the quality of pork will improve. Several requirements are hard to be implemented yet, such as the obligation to be (almost) Salmonella-free in ASI level 3. Before farmers decide to adapt to such requirements, which usually need substantial investments, they first need to know the precise epidemiological and economic implications. In the next paragraph we present a model to make such calculations.

SALMONELLA SIMULATION MODEL OF THE PORK PRODUCTION CHAIN

The several farm and firm stages of the pork production chain are linked and they influence each other's technical and economic performance. Usually the optimisation of investments in each individual stage results in sub-optimal overall chain result (Den Ouden, 1996). Salmonella is one of the most important bacteria for food-borne illness. To get more insight into the chain interactions, we developed a chain-model to evaluate the financial and epidemiological consequences of possible decisions. The objective of our model was to provide insight into the influence and effects of measures taken to reduce Salmonella prevalence in the chain and of price differentiation between prevalence classes with respect to

Salmonella. The model is a stochastic simulation model, written in Powersim Constructor version 2.5d. This type of model was chosen because of the importance of risk and uncertainty involved and the complexity of the problem. We divided the pork chain in the following stages: multiplying, fattening, transportation, slaughtering, processing and retailing (fig. 1). In each stage, there are several farms/firms and each farm/firm can make its own decisions. The possible decisions are about reductive or preventive measures concerning Salmonella. The taken measures influence the epidemiology and prevalence of Salmonella on the farm. In addition, economic performance is influenced, first because of the direct costs of the measure (large investments are depreciated on animal basis) and also because the production results may improve. The next stage starts with the animals of the former stage and their infection rate depends on the measures taken by those former farms/firms. The price of animals can be linked to the infection rate of the animals.

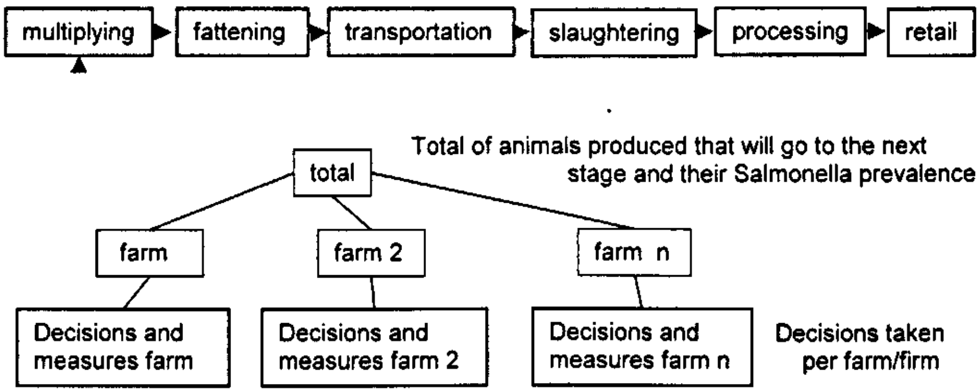

Figure 1: Design of the simulation model: main model with different stages, within each stage there are n farms/firms that make decisions

A major difficulty in conducting this type of research is the lack of quantitative data about transmission and about the effects of preventive measures. In an exploratory study that we carried out prior to the simulation study, we interviewed participants of each stage in a structured way about Salmonella control in pork. The results made clear that in practice this knowledge is limited.

We will focus in more detail now on the major results of fattening farms. The prevalence of Salmonella depends on the measures taken on a farm according to hygiene, management, contact structure and animal health care. Most measures are represented in the ASI, but their effectiveness to lower the risks for human health is highly dependent on the interaction between the stages. The prevalence of Salmonella in the fattening stage can be reduced halfway if several measures are taken (Berends, 1998). These measures include most of the requirements of the ASI level 1 and some of level 2.

As can be seen in table 2, the typical gross margin, which is defined as revenues minus variable costs, for a fattening farm is US$ 24 per pig. All input parameters can be modified to suit other countries and chain conditions. For an average Dutch fattening farm (2000 pigs) the gross margin is $144,000.

Table 2: Major technical and economic results of the typical Dutch fattening farm (PR, 1998)

Technical & economic results (in $) fattening farm*	
Price piglet (25 kg)	$ 48
Daily gain (in grams)	735
Feedcost / pig	$ 52
Price pork / kg	$ 1.5
Transportation cost / pig	$ 1.5
Miscellaneaous cost** / pig	$ 5
Rounds / year	3
Gross margin / pig	$ 24

* Exchange rate: 1 US $ ≅ 2 Dutch guilders

** Miscellaneous costs: veterinary costs, insurance, electricity, insemination, water, heating

An infection of Salmonella on a farm seems to have no significant effects on the production results. In the current price-quality system there is no financial motivation to start an (expensive) eradication or reduction program, however this is likely to change in the future. The possible positive effects of taken measures on the production results are no part of the model yet. The yearly costs required to reduce the prevalence by 50% for an average fattening farm are estimated around $ 7300 a year (Berenpas and Berends, 1995). Let us assume there is a price difference between Salmonella-free and infected pigs. The effect of this price difference is proportional with the infection rate. The farmer will only invest if the investment costs to reduce infection rate are less than the loss the farmer would incur because of the lower price for infected pigs. The price difference between infected and non-infected pigs should be between 10 and 15 % to cover the investment costs (fig. 2).

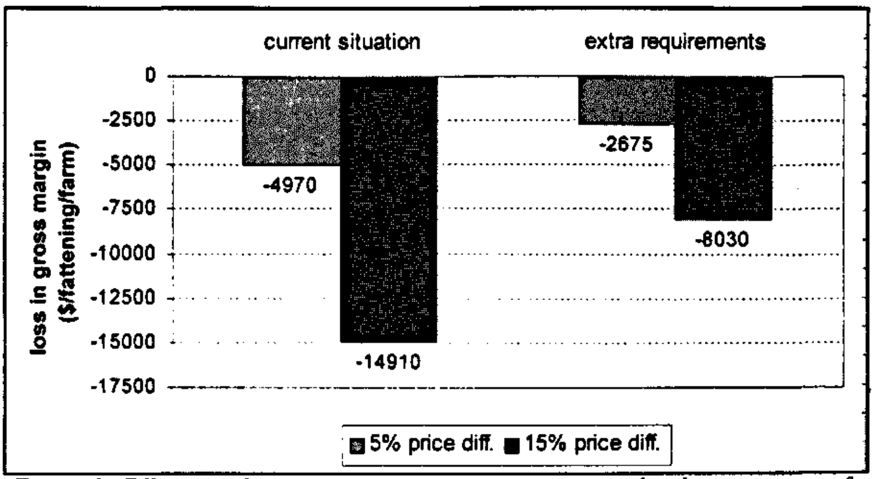

Figure 2: Effects on the gross margin at two price setting levels per average fattening farm in the current situation and the situation with extra requirements in US$

The importance of a chain approach becomes evident by an example. The transportation stage to the slaughterhouse takes several hours. In this period infected animals cannot recover, but non-infected animals can get infected within 4 to 6 hours (Berends, 1998). In the current situation the number of infected animals in a truckload can double. The best result (no additional infected animals) can be achieved by strict hygiene and operating procedures. Otherwise the prevalence reduction in the fattening stage can be cancelled out by the transportation stage.

CONCLUSION AND DISCUSSION

It is encouraging that the majority of the farms already meet several requirements, although there is still a long way to go. The model shows that the price difference has to be relatively high to cover the primary costs. But because the measures taken to reduce Salmonella prevalence are also effective for other risks, the overall quality improves. So the costs can be spread over several risks. With a system like ASI, the farmers will be more aware of the need of changing their way of working. This is important because if people know why they should act in a certain way, they will be better motivated to use measures properly. The costs have to be covered by extra income or by more certainty of selling of the animals produced. Our model gives insight into the effects of new or stricter requirements in the chain. Also the effects of investments in a stage on the other parts of the chain can be evaluated, so the effectiveness can be measured. The adaptation and introduction can also be predicted by calculating of economic consequences. On the other hand, experiences in field studies of the ASI contribute to making the model better and more veritable. The model is general in nature, so it can also be used for other stage-crossing risks. This type of joint research can improve both practice and theory of the risks in the pork production chain.

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