MICROBIAL CONTAMINATION OF PIG CARCASSES AT A SLAUGHTERHOUSE IN VIENTIANE CAPITAL, LAO PDR

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Abstract. A cross-sectional study was conducted to determine microbial contamination of pig carcasses at a slaughterhouse in Vientiane, capital of Lao People Democratic Republic (Lao PDR). Between November 2004 and April 2005, 62 pig carcasses were randomly selected. From each carcass, pooled swabs (from “1” prior to and “2” after evisceration) and 25 g of tissue of mesenteric lymph nodes (MLN) were collected. The swab samples were examined for Aerobic Plate Count (APC) and Enterobacteriaceae Counts (EBC) and cultured for Salmonella. The lymph nodes were cultured for Salmonella only. Swabs 1 and 2 had mean APC of 4.70 and 4.85 log₁₀ CFU/cm², respectively. These two means were significantly (p=0.0001) different. The means of EBC were 2.81 log₁₀ CFU/cm² for Swab 1, and 2.98 log₁₀ CFU/cm² for Swab 2. The difference were also statistical significant (p=0.0001). The frequency of Salmonella isolation from Swab 1 was 46.8%, for Swab 2 was 66.1%, and from mesenteric lymphnodes was 53.2%. Eight different Salmonella serotypes were identified. The most frequent (29.1%) serotype was S. Rissen, followed by S. Anatum (26.2%), S. Derby (18.4%), and S. Elisabethville (8.7%). The other serotypes identified were S. Amsterdam (7.8%), S. Typhimurium (4.9%), S. Agona (2.9%), and S. Enteritidis (1.9%). Results of this study showed the levels of contamination with aerobic bacteria and Enterobacteriaceae were higher than recommended standards, and the carcasses were contaminated with Salmonella.

INTRODUCTION

The slaughtering process is important to assure meat safety. To prevent microbial contamination, which affects consumer health and causes serious public health problems, appropriate slaughterhouse design and internal control are necessary. The level and type of microbial contamination are monitored for maintaining and improving the hygienic status and quality of meat produced by a slaughterhouse. This report is the first study In Lao PDR reflecting the hygiene of pigs in a slaughterhouse.

Aerobic Plate Count (APC) and Enterobacteriaceae Counts (EBC) are generally used as hygienic indicators in the food chain (Anonymous, 2001; Warriner et al., 2002; Nel et al., 2004; Zweifel et al., 2005). The APC depicts general microbial contamination. The EBC is a marker for possible fecal contamination. Feces are a main source of pathogens, such as Escherichia coli O157:H7, Salmonella or Campylobacter (WHO, 1995).

The specific objectives of this pork hygiene study in Lao PDR were: (1) to determine the contamination level using APC and EBC of pig carcasses prior to and post-evisceration in slaughtering process; (2) to estimate the Salmonella prevalence and serotypes from the carcass surfaces and mesenteric lymph nodes.
MATERIALS AND METHODS

Samples were taken from the largest slaughter house in Vientiane in the Dorn-Du District. Sixty to eighty pigs per day are processed. After mechanical stunning, the animals are suspended on a rail, bled, then submerged in a 62-68ºC water container (water changed daily prior to commencing slaughter). Dehairing is done using a machine with additional manual treatment if necessary. After spraying with tap water, the slaughtered animals are eviscerated, dropped on the floor for splitting and suspended on the rail again. After another washing, the split carcasses are left to dry in another room, then sent to market.

During 7 visits, 62 pig carcasses were randomly selected. From each carcass, two swab samples (prior to and after evisceration) and mesenteric lymph nodes were collected. The samples were stored in a cooling box and transported to the laboratory, where the microbiological analysis was performed the same day. The samples were taken by sponge swabs from the back, jowl, ham and belly of 62 pig carcasses and pooled for each carcass.

Swab samples were kept in plastic bags (Stomacher bag) for at least two minutes in 100 ml of buffered peptone water and 250 cycles per minutes of a peristaltic Stomacher was performed. Thereafter, serial ten-fold dilutions for APC and EBC were performed.

Mesenteric lymph nodes (MLN) were placed in boiling water for 3 seconds to eliminate superficial contamination (Swanenburg et al, 2001), and cut into small pieces with sterile devices. Thereafter, 25 g was transferred into a stomacher bag, 225 ml of BPW was added and homogenized at about 250 cycles per minute for two minutes to detect Salmonella.

RESULTS

Aerobic Plate Count

The APC was calculated as log10 CFU of APC per cm2 (Table 1). Generally, the APC ranged from 4.4 to 4.9 with a mean of 4.70 log10 CFU/cm2 for Swab 1. In Swab 2, the results ranged from 4.5 to 5.3 with a mean of 4.85 log10 CFU/cm2. Overall, the difference between the log10 CFU/cm2 of the two swabs was significant (p=0.0001).

Enterobacteriaceae Counts

The EBC was obtained by culturing the pooled swab samples like the APC (Table 1) and calculated in log10 CFU of EBC per cm2. In Swab 1, the EBC ranged from 2.3 to 3.1 with a mean of 2.81. Swab 2 values ranged from 2.1 to 3.3 with a mean of 2.98. Overall, the log10 CFU/cm2 of EBC was significantly (p=0.0001) different between Swab 1 and Swab 2.

Salmonella

Of 186 samples (2 swabs and 1 MLN per
carcass), 103 (55.4%) were positive for Salmonella. Table 2 shows the prevalence of Salmonella obtained from each type of sample. Salmonella was found more frequently (66.1%, 95% CI: 52.9 - 77.4) in Swab 2, followed by the MLN (53.2%, 95% CI: 40.2 - 65.8) then swab 1 (46.8%, 95% CI: 34.2 - 59.8). No significant (p=0.088) difference was observed among these data.

Serotyping

Eight serotypes were identified from 103 isolates (Fig 1). The most frequent (29.1%) serotype was Salmonella Rissen, followed by S. Anatum (27.2%), S. Derby (19.4%), and S. Elisabethville (7.8%). The other serotypes identified were S. Amsterdam (7.8%), S. Typhimurium (3.9%), S. Agona (2.9%), and S. Enteritidis (1.9%). These serotypes were found in all types of samples, with the exception of S. Enteritidis, which was isolated from Swab 2 only.

**DISCUSSION**

In this study, the APC ranged from 4.4 log_{10}CFU/cm^2 to 5.3 log_{10}CFU/cm^2. These findings are similar to those obtained by Pearce et al (2004). Those authors obtained an APC of 4.46 log_{10}CFU/cm^2 (belly) and 4.75 log_{10}CFU/cm^2 (neck) at dehairing. Nevertheless, the mean APC in Swab 2 (at the end of the process) of 4.85 log_{10}CFU/cm^2, was much higher than the results obtained by Pearce et al (2004) with were 3.65 log_{10}CFU/cm^2 (belly) and 3.53 log_{10}CFU/cm^2 (neck). The decrease could be due to the singeing. According to other studies (Rivas et al, 2000; Warriner et al, 2002) in this step the microbial load on the surface of carcass usually decreases. In the slaughterhouse investigated here, no singeing took place.

Similar results were obtained for EBC. All samples had EBC above the acceptable value.
of 2.0 log$_{10}$CFU set by Decision 2001/471/EC of the EU Commission (Anonymous, 2001). This study found levels ranging from 2.3 to 3.1 and 2.1 to 3.3 log$_{10}$CFU/cm$^2$ for Swab 1 and Swab 2, respectively. The overall numbers of EBC were significantly different ($p = 0.0001$) between Swab 1 and Swab 2. Increase in number of EBCs was probably caused by contamination during subsequent operations, such as evisceration, washing and cutting. In this slaughterhouse, after evisceration, the carcasses were laid down on the floor for cutting.

Sources of Salmonella in pork carcasses and products have been investigated over the years in many developed countries. For example, the SALINPORK Project (Danilo et al., 2000) explored various epidemiological and economic aspects of Salmonella in pork. The occurrence of Salmonella in Swab 2 was higher (66.1%) than in Swab 1 (46.8%). Such an increase on carcass surfaces during processing is well documented (Gill and Jones, 1997). It has been attributed to the contamination of carcasses in the gastrointestinal tract, mouth and tonsils during the course of processing. Salmonella can also come from the slaughterhouse environment as well as from humans, if hygienic standards are extremely low (Warriner et al., 2002). Therefore, the high proportion of positive Swab 2 samples compared to that obtained from Swab 1 samples is due to increased contamination of carcasses along the slaughter line. The rotating flails that are used to remove hairs may squeeze feces from the anus, potentially contaminating the equipment with fecal microorganisms, including Salmonella, and hence contaminate the carcass (Borch et al., 1996). Thus, the presence of Salmonella in Swab 1 samples strongly suggests carcass contamination during deharing and/or during earlier stages of the procedure (Berends et al., 1997).

In particular the evisceration process, including bung dropping, and the removal of the pluck-set have been identified as critical control points. The cutting process is not normally considered to be an important source of carcass contamination (Berends et al., 1997; Gill and Jones, 1997). In this study, Swab 2 was taken at the splitting stage after washing the carcass. This was done to monitor for the presence of Salmonella on the final carcass.

With particular reference to the serotypes obtained from the lymphnodes, S. Rissen (9), S. Anatum (9), S. Derby (9), S. Typhimurium (2), S. Elisabethville (2), S. Amsterdam (1) and S. Agona (1) were obtained. In three cases, three serotypes were found per slaughtered pig: 1. S. Rissen, S. Anatum and S. Rissen; 2. S. Anatum, S. Rissen and S. Anatum; 3. S. Derby, S. Anatum and S. Anatum

Finally, in 4 cases both swabs were positive with the same serotype (2 with S. Rissen, 1 with S. Anatum, and 1 with S. Derby).

In Lao PDR, Salmonella is commonly found in all types of meat and cooking materials (Nakamura et al., 2004). To date, there is no information regarding the Salmonella serotypes in Lao PDR. The findings given here are similar to the serotypes obtained from neighboring countries. Here, the most common serovars from all sources (human, pig, poultry) were S. Weltevreden, S. Enteritidis, S. Anatum, S. Derby, S. Typhimurium, S. Rissen, S. Stanley, S. Panama, S. Agona, and S. Paratyphi B var Java (Bangtrakulnonth et al., 2004). From a study in the Mekong Delta in Vietnam, Tran et al. (2004) found the most predominant Salmonella serotypes were S. Javiana, S. Derby, and S. Weltevreden.

The results obtained here indicate that microbiological contamination of pork carcasses during the slaughter processing in the abattoir Dorn-Du was high. The carcasses were contaminated with aerobic and Enterobacteriaceae bacteria, as well as with Salmonella. Salmonella Enteritidis, which is considered a risk to human health, was among the Salmonella isolates found. Microbiological contamination could be due to various aspects...
that include environmental slaughterhouse conditions, as well as pig and farm managerial factors.

ACKNOWLEDGEMENTS

This research project was funded by the European Union and the Asia-Link through the 1st Joint Master of Science in Veterinary Public Health, Chiang Mai University, Thailand and the Freie Universitaet Berlin, Germany.

REFERENCES


