# Longitudinal studies of total viable counts on pig skin surface along the slaughter process by using a modified agar contact method

Fürstenberg R.[1], Meemken D.[1], Langforth S.[1], Große-Kleimann J.[2], Kreienbrock L.[2], Langkabel N.[1]

[1]Freie Universität Berlin, Institute of Food Safety and Food Hygiene, Working Group Meat Hygiene, Berlin, Germany; roland.fuerstenberg@fu-berlin.de

[2]Department of Biometry, Epidemiology and Information Processing, WHO Collaborating Centre for Research and Training for Health at the Human-Animal-Environment Interface, University of Veterinary Medicine Hannover, Foundation, Hanover, Germany

Keywords: swine, microbiological load, abattoir

## Background

During pig slaughter, a risk of carcass contamination, recontamination and cross-contamination exists at multiple processing steps and forms a hazard for consumer health. Thus, monitoring of contamination levels of each carcass at various processing stages is useful to identify responsible processes for increasing microbiological loads. (Moura-Alves et al. 2022)

Microbiological investigations, as defined in the European Reg. (EC) No 2073/2005 enable the control of process hygiene during slaughtering (EFSA 2007).

The aim of the study was to analyze the total viable count (TVC) of aerobic mesophilic bacteria on fattening pig skin and carcass surfaces along the slaughter process in a longitudinal manner from lairage to the end of the slaughter process by using a new sampling technique.

## Materials and Methods

Sampling was conducted between May and September 2021 at a pig abattoir located in Northwest Germany with a slaughter capacity of 15,000 pigs per week. The objective was to examine ten herds, each with nine slaughter pigs, longitudinally along the slaughter line by sampling two herds per day.

Marked pigs were sampled by using agar contact plates in the perianal area at seven processing stages along the slaughter line:

1. lairage before showering
2. lairage after showering
3. after stunning
4. after scalding/dehairing
5. after singeing
6. after evisceration
7. before chilling

For microbiological analysis the agar of each sample was dislodged from the petri dish using sterile instruments and mixed in a stomacher bag with Buffered Peptone Water before dilution series were created. Subsequently, TVC was quantitatively analyzed using drop plating method.

For statistical analyses, TVC outcomes were transformed via logarithm to the base of ten, as original values in colony forming units per square centimeter (cfu/cm$^2$) showed skewed distribution. Microbiological reduction from one stage to the next of all seven stages, was tested for statistical significance using analysis of variance (ANOVA) with repeated measurement and herd as a separate influencing factor.


*SafePork 2023: The 14th International Symposium on the Epidemiology and Control Biological, Chemical and Physical Hazards in Pigs and Pork*, New Orleans, LA, United States, May 15–17, 2023
https://doi.org/10.31274/safepork.16356

## Results

Mean TVC values increased significantly ($p<0.0001$) from arrival of the pigs at the abattoir (5.70 log cfu/cm$^2$) to the stage "after showering" in the lairage (6.27 log cfu/cm$^2$). The subsequent increase of TVC at the stage "after stunning" (6.48 log cfu/cm$^2$) was not statistically significant ($p=0.0826$). At further processing stages, statistically significant decreases of the mean TVC values to 3.71 log cfu/cm$^2$ "after scalding/dehairing" ($p<0.0001$) and to 2.79 log cfu/cm$^2$ "after singeing" ($p<0.0001$) were seen. The reduction of TVC in the following processing stages resulting in 2.59 log cfu/cm$^2$ "before chilling" was not statistically significant ($p=0.9759$).

In total, the distribution of the predicted values in the repeated measurement ANOVA showed a reduction of mean TVC by 3.11 log steps on herd level by comparing the bacterial load of the first to the last processing stage (Fig 1).

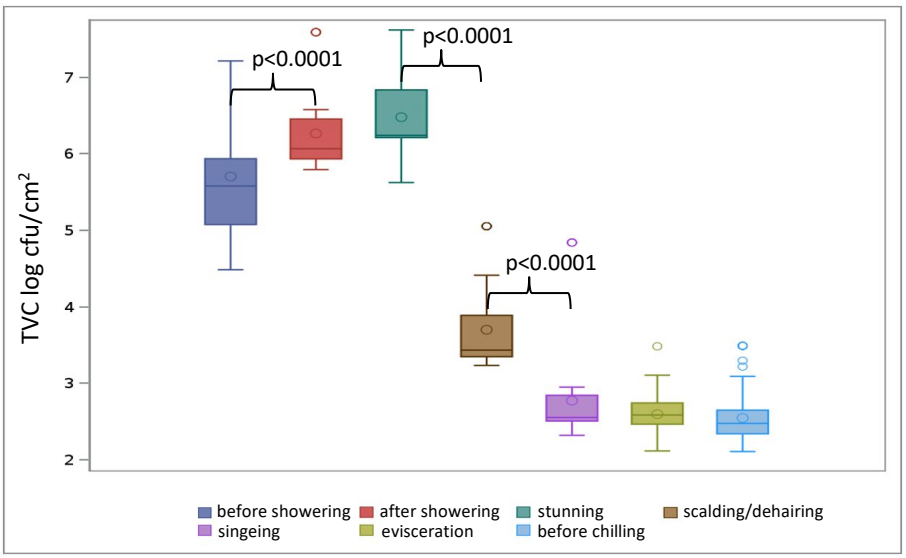


**Figure 1:** Course of the prediction values of the logarithmic TVC calculated by repeated measurement ANOVA, regarding the individual herd variations at seven sampling stages

## Discussion and Conclusion

Sampling pig skin with agar contact plates was selected for two reasons. The method enabled a fast, simple, and low-stress sampling procedure on live and non-fixed pigs in the lairage pens. Additionally, this procedure allowed longitudinal sampling of tracked individual pigs at each of the seven processing stages without interrupting the workflow.

The statistically significant increase of TVC at the beginning of the slaughter process could be due to several factors like delivering dirty pigs, loosening of dried feces on pig skin through showering, and the subsequent sampling by agar contact plates with low pressure on the surface. Furthermore, the pigs laid down in moist with dirt and feces contaminated areas in the lairage pens. After stunning, leakage of excrement from the rectum by slackening sphincter muscles can be assumed as another possible reason.

Scalding and dehairing led to significant reductions of surface bacteria count in further processing, especially with ideal period of staying as well as with optimal temperature conditions in the condenser and the singeing machine (Spescha et al. 2006) which could be confirmed by the study presented here.

Our investigation showed that sampling pig skin and carcasses in the perianal region with agar contact plates could be used to identify risk factors in the slaughter process and contaminated delivery batches. As this sampling technique is not standard approved for process controls, it should only be used in special cases. However, TVC values collected by such a simple sampling technique could be a meaningful and practicable way for the assessment and optimization of slaughter hygiene.

## Literature

**Commission Regulation (EC) No 2073/2005** of 15 November 2005 on microbiological criteria for foodstuffs. *OJ. EU L 338*, 22.12.2005, p. 1-26. http://data.europa.eu/eli/reg/2005/2073/oj

**EFSA. (2007).** Opinion of the Scientific Panel on biological hazards (BIOHAZ) on microbiological criteria and targets based on risk analysis. *EFSA Journal*, *5*(3), p. 462. https://doi.org/https://doi.org/10.2903/j.efsa.2007.462

**Moura-Alves, M., Carvalho M., Baggio Ribeiro D. H., Barbosa J., Silveira L., Pista A., Pinto H. P., Saraiva C., Teixeira P. and Esteves A. (2022).** Hygiene Indicators and Salmonellae on Surfaces of Swine Carcasses from Two Slaughterhouses in Northern Portugal. *Journal of Food Protection, 85*(11), p. 1566-1575. https://doi.org/10.4315/JFP-21-312

**Spescha, C., Stephan, R., and Zweifel, C. (2006).** Microbiological Contamination of Pig Carcasses at Different Stages of Slaughter in Two European Union–Approved Abattoirs. *Journal of Food Protection*, *69*(11), p. 2568-2575. https://doi.org/10.4315/0362-028x-69.11.2568

## Funding

The study was conducted in the joint research project:
Development and implementation of technological procedures for the reduction of microbiological contaminants in the pig slaughtering process “KontRed” (Grant number: 281C104A18).

With support from

Federal Ministry of Food and Agriculture

by decision of the German Bundestag

Project manager

Federal Office for Agriculture and Food