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Microbiological contamination of cattle and pig carcasses at five abattoirs determined by swab sampling in accordance with EU Decision 2001/471/EC

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Abstract

A total of 800 cattle carcasses (abattoir A: $n = 200$; B: $n = 150$; C: $n = 150$; D: $n = 150$, E: $n = 150$) and 650 pig carcasses (abattoir A: $n = 200$; B: $n = 150$; C: $n = 150$; D: $n = 150$) were examined at five Swiss abattoirs with an annual slaughtering capacity >10 million kg. Weekly, 10 cattle and 10 pig carcasses were sampled at four sites by the wet–dry double swab technique. From each carcass the samples were pooled and examined for total viable counts (TVC) and *Enterobacteriaceae*. At the abattoirs, mean log TVCs from cattle carcasses ranged from 2.1 to 3.1 cm^{-2} and those from pig carcasses from 2.2 to 3.7 cm^{-2}. Daily TVC mean log values showed significant differences between abattoirs ($P < 0.05$), whereas no significant differences were detected between animal species. On average, *Enterobacteriaceae* were detected (i) in low counts, (ii) on 31.0% of cattle and on 20.2% of pig carcasses, and (iii) more frequently and in higher counts on cattle than on pig carcasses ($P < 0.05$). Data from this study indicate that the wet–dry double swab technique is suitable to determine microbiological contamination of cattle and pig carcasses in accordance with EU Decision 2001/471/EC. For samples obtained by the non-destructive technique from cattle and pig carcasses, the following microbiological performance criteria are proposed: Daily mean log values are acceptable, marginal, and unacceptable for TVC when they are <3.00, 3.00–4.00, >4.00 cm^{-2}, and for *Enterobacteriaceae* when they are <1.00, 1.00–2.00, and >2.00 cm^{-2}. However, such values have to be seen merely as baselines. It is important to implement a monitoring system based on abattoir-specific data and criteria as permitted by quality control chart methods.

Keywords: Cattle and pig carcasses; Decision 2001/471/EC; Wet–dry double swab technique; Total viable counts; *Enterobacteriaceae*; Performance criteria

1. Introduction

Strict maintenance of good practices of slaughter hygiene in meat production is of central importance for the prevention of microbial carcass contamination in the interest of ensuring both health protection and meat quality. To enable risks involved to be estimated and appropriate measures to be taken, analysis of the slaughtering process has to be complemented by collection of abattoir-specific microbiological monitoring data in accordance with hazard analysis critical control point (HACCP) principles. A recent study showed that regular microbiological examinations of carcasses allowed reliable conclusions to be drawn with regard to long-term hygienic conditions in abattoirs (Zweifel & Stephan, 2003a).

Swiss meat hygiene regulation and Directive 64/433/EEC on health conditions for the production and marketing of fresh meat of the European Union (EU) outline the requirements for the systematic monitoring of

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hygienic conditions (Anon., 1964, 1995a). To ensure EU-wide microbial performance standards, the Commission of the European Community enacted Decision 2001/471/EC (Anon., 2001). This decision obliges operators of meat establishments to conduct regular checks on general hygiene conditions of the production process, including microbiological controls in accordance with HACCP methodology principles. For the microbiological monitoring of carcasses, Decision 2001/471/EC relies on total viable counts (TVC) as indicators of hygiene and *Enterobacteriaceae* as indicators of faecal contamination, and defines microbiological performance criteria for samples obtained by the destructive sampling technique. The meat industry often prefers non-destructive techniques for reasons of practicability. The non-destructive wet–dry double swab technique is also authorized, but limits for microbiological performance criteria have to be evaluated when applying this technique. Recent studies suggested that swabbing with abrasive materials and applying the wet–dry double swab technique may be a suitable alternative to excision (Dorsa, Cutter, & Siragusa, 1996; Ellerbroek, 2003; Gill & Jones, 2000; Ware, Kain, Sofos, Belk, & Smith, 1999). A quantitative conversion factor between excision and swabbing has not yet been established. Gill, Badoni, and McGinnis (2001) even suggested that any assumed relationship between swabbing and excision would be tentative.

The aim of this study was, in accordance with the requirements of Decision 2001/471/EC, (i) to obtain data on microbiological contamination of cattle and pig carcasses by the wet–dry double swab technique at Swiss abattoirs, (ii) to evaluate time trend graphs of daily mean log values for the different abattoirs and slaughtered species, (iii) to calculate boundaries for abattoir-specific quality control charts (QCC), and (iv) to suggest baselines for microbiological performance criteria for the wet–dry double swab technique.

2. Materials and methods

2.1. Abattoirs

This study was based on investigations carried out within eight months (from June 2003 to January 2004) in five, EU-approved slaughterhouses (A–E). At abattoir A, B, C, and D, cattle and pigs were slaughtered on separate mechanized lines, whereas at abattoir E only cattle were slaughtered. The five slaughterhouses were distributed throughout Switzerland and represented the majority of slaughterhouse with an annual slaughtering capacity of >10 million kg. In the year 2003, abattoir A slaughtered 14.3 million kg (cattle: 6.7 million kg, pig: 7.6 million kg), abattoir B 16.1 million kg (cattle: 8.4 million kg, pig: 7.7 million kg), abattoir C 14.6 million kg (cattle: 7.0 million kg, pig: 7.6 million kg), abattoir D 36.2 million kg (cattle: 12.6 million kg, pig: 23.7 million kg), and abattoir E: 16.3 million kg (cattle).

2.2. Sampling

Sampling, microbiological examinations, and analysis of results were performed in accordance with Decision 2001/471/EC (Anon., 2001). In total, samples from 800 cattle (abattoir A: $n = 200$; abattoir B: $n = 150$; abattoir C: $n = 150$; abattoir D: $n = 150$, abattoir E: $n = 150$) and 650 pig carcasses (abattoir A: $n = 200$; abattoir B: $n = 150$; abattoir C: $n = 150$; abattoir D: $n = 150$) were examined. At each abattoir, sampling was performed weekly involving 10 cattle and 10 pig carcasses. The day of sampling was changed each week. Samples were obtained by the wet–dry double swab technique from four different sites (4×100 cm^2) stipulated by the EU Decision (cattle: neck, brisket, flank, and rump; pig: back, cheek, ham, and belly). At each sampling site, a moistened swab (0.1% buffered peptone water + 0.85% sodium chloride solution) was rubbed vertically, horizontally, and diagonally across the sampling site delineated by a template. Then, the same sampling procedure was repeated by a dry swab. Samples were subsequently placed into cool boxes, and microbiological examinations were carried out 2–4 h after sampling.

2.3. TVC and Enterobacteriaceae

Pooled swabs of each carcass were homogenized together for 120 s in 100 ml 0.1% buffered peptone water + 0.85% sodium chloride solution in a stomacher. Suspensions were plated with a spiral plater (Autoplate 4000, Spiral Biotech, Bethesda, MD) on plate count agar (Oxoid Ltd., Hampshire, UK) and violet red bile glucose agar (VRBG agar, BBL, Cockeysville, MD). Plate count agar was incubated aerobically for 72 h at 30 °C and VRBG agar for 48 h at 30 °C under anaerobic conditions provided by commercial gas packs (BBL 270304). Manual counting was applied. The detection limit was 5.0×10^0 colony-forming units (CFU) cm^{-2}.

2.4. Analysis of results

Colony counts were transformed into log CFU cm^{-2}. For samples in which bacterial counts were below the detection limit, a log value of zero was used for calculations. All analysis was carried out separately for each species. Microbiological results were depicted as time trend graphs of daily mean log values. For abattoir-specific QCC, upper and lower action levels (UAL, LAL; 95% range) and upper and lower warn level (UWL, LWL; 80% range) were calculated (Anon., 1995b; Dura, Stephan, Kühn, & Untermann, 1999).