BACTERIAL CONTAMINATION OF CALF CARCASSES
DURING PRODUCTION CYCLE

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Abstract

The objective of the presented study was to determine microbial contamination of calf muscle tissues in relation to slaughtering process of calves during a slaughter day. In order to determine the total aerobic bacteria count, and the presence of bacteria from the Enterobacteriaceae family and enterococci, 32 carcasses were examined (eight each slaughter day), while 40 carcasses (10 each slaughter day) were examined for the detection of Salmonella organisms. Microbiological evaluation of each bacterial group was performed according to the Polish Norms. In most cases, no significant differences were reported between the total aerobic counts on calf carcass surfaces as determined at each slaughter cycle. The daily log mean values were lower by 1 up to 1.5 log, respectively, than the maximal bacteria count (M). Bacteria from the Enterobacteriaceae family were isolated from 59.4% of the evaluated samples. However, contamination with these bacteria was insignificant – 1.7 x 10 cfu/cm². Enterococci were isolated from all investigated samples and contamination ranged from 1.1 x 10 cfu/cm² up to 4.1 x 10⁶ cfu/cm². Salmonella strains were not found in any of the evaluated samples. The order of the slaughtering calves during a slaughter day and the day of the week when the examination was performed did not have any influence on total microbial contamination of carcasses. Thus, sanitary conditions in the examined abattoir were satisfactory and slaughter process was conducted at a high quality level.

Key words: calf, slaughtering, carcass, bacterial contamination.

Microflora of fresh meat is differentiated in terms of qualitative and quantitative estimates. The hygiene conditions at the production line for slaughter animals are one of the critical factors influencing both, the level of carcass microbial contamination and the type of determined microorganisms. Experimental studies have shown that total aerobic bacterial contamination depends on a slaughter site and may range in bovine carcasses from 10⁶/cm² up to 10⁹/cm² (4, 17). Investigations on sheep have shown significantly lower variation of total bacterial contamination of carcasses that ranged within 10⁶–10⁷/cm² (3). It was shown that a total bacterial contamination level of carcasses depended on animal species. Average carcass contamination (cfu/cm²) for cattle, horse, pig and poultry were found at 10³–10⁴, 10⁵, 10⁵–10⁶ and 10³, respectively (3, 6, 19).

Fresh meat is also a potential source of bacteria associated with food enteropathies, such as Salmonella, Campylobacter, Yersinia enterocolitica, verotoxoe strains of E. coli, and pathogenic staphylococci. Epidemiological data published by the European Food Safety Authority indicate that broiler, pork, and beef and its products contributed to 12% of verified outbreaks caused by Salmonella and over 50% verified cases (mainly poultry meat) of campylobacteriosis in the European Union countries in 2009. Likewise, beef and products thereof were reported as the source in three of the 18 verified pathogenic E. coli outbreaks. Pathogenic staphylococci were isolated from 9% of the bovine carcasses obtained in the high capacity abattoir and from 16% of carcass samples in the low capacity abattoir. In most cases, the level of contamination with the abovementioned microorganisms did not exceed 50 cfu/cm²; however in one sample obtained from the low capacity slaughterhouse 266 cfu/cm² was reached (4, 5, 7, 15).

The Commission Regulation (EC) No. 2073/2005 (1) sets out the process hygiene criteria in slaughterhouse and defines the counts of aerobic bacteria and microorganisms from the Enterobacteriaceae family (daily mean log value) on carcass surface after dressing but before chilling, as well as examination for the presence of Salmonella.

The objective of the presented study was to evaluate the hygiene conditions of calf slaughter process in relation to the number of slaughtered animals during a working day and bacterial contamination level of the obtained carcasses.
Material and Methods

The studies were carried out on carcasses obtained from the abattoirs approved for placing their products on the market. In the evaluated slaughterhouse, animals were slaughtered in one cycle, on a fixed day of the week (most often Monday) and daily average number of slaughtered calves was 67. In order to determine the total count of aerobic bacteria, bacteria from the Enterobacteriaceae family, and enterococci, 32 carcasses were examined (eight carcasses during each slaughter cycle), while to detect the presence of Salmonella – 40 carcasses were studied (10 carcasses during each slaughter cycle). The microbiological denotations of each microorganism group was performed in compliance with the methodology of the Polish Norms (9-12). The samples were collected by the destructive and non-destructive methods (swabbing technique with sterile cotton swab) from the shoulder, breast, leg, and flank of the carcasses according to the Polish Norm (13). Each daily slaughter cycle was divided into four stages. In stage I, the number of slaughtered animals did not exceed 37% of total animals for slaughter, in stage II – the number of animals reached 50%-59%, in stage III – 60%-80%, while in stage IV it reached always above 81%. During each stage, the samples from two randomly chosen carcasses were taken (n=8). The calculation of daily mean log value in the investigated slaughter cycles (days) was based on the results obtained for the samples taken in II, III, and IV stages (n=6). The obtained results of total bacterial contamination were analysed statistically with the use of statistical software and the mean values and standard deviations were calculated. The effect of variation factor was determined on the basis of analysis of variance with the estimation of T-Tukey’s multiple confidence intervals for P≤0.05.

Results and Discussion

The results of total bacterial contamination of calf carcasses are presented in Tables 1 and 2. It was found that the order of the slaughtering calves during a slaughter day did not affect significantly the total bacterial counts on the examined carcass surfaces (Table 1).

Table 1
Total bacterial contamination (log cfu/cm²) of calf carcass surfaces at each stage of daily slaughter cycle (n = 8)

<table>
<thead>
<tr>
<th>Stage</th>
<th>SD</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>3.83a ±0.9</td>
<td>2.12 – 4.68</td>
</tr>
<tr>
<td>II</td>
<td>3.66a ±0.2</td>
<td>3.36 – 3.86</td>
</tr>
<tr>
<td>III</td>
<td>3.85a ±0.3</td>
<td>3.00 – 4.61</td>
</tr>
<tr>
<td>IV</td>
<td>3.54a ±0.4</td>
<td>2.89 – 4.04</td>
</tr>
<tr>
<td>I-IV</td>
<td>3.72a ±0.5</td>
<td>2.12 – 4.68</td>
</tr>
</tbody>
</table>

a - means denoted by the same letters do not differ significantly at P≤ 0.05.

The obtained results have shown that the total aerobic bacteria count on calf carcasses in each slaughter stage ranged from 3.5 x 10² cfu/cm² up to 7.0 x 10³ cfu/cm². In most cases, no significant differences of total bacterial contamination of carcasses in each slaughter stage were obtained. At stage II, a significantly higher total aerobic bacteria count (10⁴ cfu/cm²) was observed, when compared to stage I where 2.3 x 10⁴ cfu/cm² was reached (Table 2).

Table 2
Total bacterial contamination (daily mean log value – log cfu/cm²) of calf carcasses at each slaughter cycle (n = 6)

<table>
<thead>
<tr>
<th>Cycle</th>
<th>SD</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3.36a ±0.3</td>
<td>2.89 – 3.77</td>
</tr>
<tr>
<td>2</td>
<td>4.00b ±0.3</td>
<td>3.69 – 4.61</td>
</tr>
<tr>
<td>3</td>
<td>3.67ab ±0.4</td>
<td>3.2 – 4.26</td>
</tr>
<tr>
<td>4</td>
<td>3.72ab ±0.2</td>
<td>3.53 – 4.03</td>
</tr>
</tbody>
</table>

a,b - means denoted by different letters are significantly different at P≤ 0.05.

The obtained daily mean log values of bacterial contamination were lower by 1 up to about 1.5 log respectively, than the maximal bacterial count (M) for the slaughter process hygiene standards for cattle set by the Commission Regulation No. 2073/2005 (1). According to the criteria for evaluation of slaughter process hygiene, described in the abovementioned Regulation, the quality of the calf carcasses obtained in slaughter stage I was satisfactory, and acceptable in the other three stages. Currently available literature data do not provide sufficient information about total bacterial contamination of calf carcasses; however the data concerning bovine carcasses report total bacterial contamination at the log level of 1.6-3.07 cfu/cm² (2, 14, 20).

In our study, bacteria from the Enterobacteriaceae family were recognised in 59.4% of the examined samples. However, bacterial contamination appeared to be quite low, at 1.7 x 10 cfu/cm² level and did not exceed the recommended limits for cattle (1.5-2.5 log cfu/cm²). Available literature data present substantially higher levels that surpass permissible limits for contamination with bacteria isolated in bovine carcasses (14, 20).

In the current study, enterococci were isolated from all investigated samples and this bacterial contamination level oscillated between 1.1 x 10 cfu/cm² and 4.1 x 10⁵ cfu/cm², which was higher when compared to the level of cattle carcass bacterial contamination determined in our previous study, where 3.2 x 10⁴ cfu/cm² were not exceeded (8). Although the Commission Regulation No. 2073/2005 does not mention enterococci as a crucial hygiene process criterion, the bacterial contamination level with these microorganisms may serve as an accessory indicator of the production hygiene conditions.
The presence of *Salmonella* was not detected in any of the examined samples. However, the results of other reports seem to be discrepant. It was shown that the percentage of samples tested positive for *Salmonella* was 12.73% and 20% of the evaluated carcasses of young cattle and calves (16). Furthermore, all investigated carcasses of adult cattle in this study were qualified as *Salmonella*-free. Other studies have shown the incidence of *Salmonella* in 1.8% of the investigated bovine carcasses (18). Depending on the age of the slaughtered cattle, the percentage of carcasses contaminated with *Salmonella* ranged from 1.7% (individuals over 6 years of age) to 5.0% (individuals of unknown age). The *Salmonella* microorganisms were not detected only in the carcasses of cattle younger than 36 months of age.

In conclusion, the obtained results have shown no effect of the different number of slaughtered animals during slaughter day on bacteriological contamination level determined on the calf carcass tissues. Due to effective supervision procedures, HACCP system standards, and optimal sanitary-veterinary control of the slaughter process, it may be considered that slaughter of calves in the examined abattoir is performed at a high quality level.

**References**

9. PN-EN ISO 4833:2004 Microbiology of food and animal feeding stuffs - Horizontal method for the enumeration of microorganisms – Colony-count technique at 30°C.
10. PN-EN ISO 6579:2003 Microbiology of food and animal feeding stuffs - Horizontal method for the detection of *Salmonella* spp.