Assessment of the hygienic status of raw pork used for the production of uncooked smoked ham and bacon

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In many countries Staphylococcus (S.) aureus and Listeria (L.) monocytogenes are considered important sources of food poisoning in addition to Salmonella (BEAN and GRIFFIN, 1990, GATTEAU, 1993). Because of its enterotoxins S. aureus is one of the most frequent causes of disease in humans. Listeria and Salmonella are responsible for numerous enteritides in humans. Pork and uncooked smoked ham made from this meat may contain large numbers of pathogenic bacteria when handled, produced and processed under poor hygienic conditions. Strong contamination of the raw material not only leads to organoleptic deviations but also presents considerable health risks (DOYLE, 2000)

Material and Methods
A total of 90 samples (fresh, salted and processed smoked ham and bacon) were tested for the presence of Staphylococcus spp., S. aureus, Micrococcaceae, Salmonella and Listeria.

All samples were tested with cultural microbiological methods.

1. The determination of the total number of aerobic microorganisms: After preparing the dilutions pour-plates were made in duplicate using standard I agar as culture medium. The incubation was at 30 °C for 72 h.
2. Detection of Staphylococcus spp.: After preparing the dilutions two selective media (Baird-Parker and Kranep-Agar) were inoculated and incubated at 37 °C for 48 h.
3. Detection of Salmonella: The samples were first incubated in peptone-water-pre-enrichment at 37 °C for 24 h and then in Rappaport-Vassiliadis enrichment at 42 °C for 24 h. Rambach and XLD agars were used as selective media. Isolates suspected to be Salmonella were confirmed biochemically and by their plasmid profiles.
4. Detection of Listeria: For each sample, 25 g of meat was placed in 225 ml of Listeria-pre-enrichment and incubated at 30 °C. After incubation for 24 h and 48 h and after a week subcultures were made on Palcam and Oxford selective-medium and incubated another 24 h at 37 °C. Suspected Listeria colonies were
inoculated on standard I agar; *Listeria* spp. were identified according to the
criteria in Bergey's Manual (1988). Further differentiation was made with
API-*Listeria®*.

**Results**
The results are summarized in the following tables:

Tab. 1 Presence of *Staphylococcus* spp., *Micrococcaceae* and *S. aureus* in fresh ham and flank, after
salting and as end-product ham and bacon.

<table>
<thead>
<tr>
<th>Type of meat</th>
<th>No. of samples</th>
<th><em>Micrococcaceae</em> positive</th>
<th><em>Staphylococcus</em> spp. positive</th>
<th><em>S. aureus</em> positive</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Fresh - ham</td>
<td>18</td>
<td>8 (44,4 %)</td>
<td>8 (44,4 %)</td>
<td>2 (11,1 %)</td>
</tr>
<tr>
<td></td>
<td>- flank (bacon)</td>
<td>12</td>
<td>11 (91,6 %)</td>
<td>7 (58,3 %)</td>
</tr>
<tr>
<td>B. Salted - ham</td>
<td>18</td>
<td>12 (66,6 %)</td>
<td>11 (91,1 %)</td>
<td>1 (5,5 %)</td>
</tr>
<tr>
<td></td>
<td>- flank (bacon)</td>
<td>12</td>
<td>10 (83,3 %)</td>
<td>8 (66,6 %)</td>
</tr>
<tr>
<td>C. End-product - ham</td>
<td>18</td>
<td>4 (22,2 %)</td>
<td>8 (44,4 %)</td>
<td>1 (5,5 %)</td>
</tr>
<tr>
<td></td>
<td>- flank (bacon)</td>
<td>12</td>
<td>3 (25,0 %)</td>
<td>10 (83,3 %)</td>
</tr>
</tbody>
</table>

Interestingly *Staphylococcus* spp. and *Staphylococcus* *aureus* were detected in ham
and bacon as end-product.

Table 2 contains the results of the determination of *Listeria* spp. in fresh meat (ham and flank), in
salted meat and in the finished products (smoked ham and bacon).

Tab. 2 Presence of *Listeria*

<table>
<thead>
<tr>
<th>Type of meat</th>
<th>No. of samples</th>
<th><em>Listeria</em> positive</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Fresh - ham</td>
<td>18</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>- flank (bacon)</td>
<td>12</td>
</tr>
<tr>
<td>B. Salted meat - ham</td>
<td>18</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>- flank (bacon)</td>
<td>12</td>
</tr>
<tr>
<td>C. End-product - ham</td>
<td>18</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>- flank (bacon)</td>
<td>12</td>
</tr>
</tbody>
</table>

Five samples (16,6 %) of fresh meat were *Listeria* spp. positive. After three weeks
in salt, *Listeria* spp. could be found in only three samples. No *Listeria* could be
determined in the finished ham and bacon. Biochemical differentiation led to the
identification of *Listeria weishimeri* only. None of the *Listeria*-suspicous isolates
could be identified as *L. monocytogenes*.
None of the samples tested contained *Salmonella*.

It was determined that the total number of microorganisms in fresh meat may vary widely. The hygienic quality of fresh meat from some suppliers was very good (<10^2 cfu/g).

**Discussion**

Raw pork from different suppliers showed striking differences in the results of the aerobic plate counts and in the prevalence of different food-associated pathogens such as *Staphylococcus (S.)* aureus and *Listeria* spp. It may be concluded that the handling of the animals during slaughter and the subsequent handling of the raw meat have an enormous impact on the microbiological quality of this raw material. Therefore, to ensure impeccable quality of the finished products the utmost hygienic precautions have to be taken during slaughter and further processing of meat.

Although the prevalence of *S. aureus* and *Listeria* decreases during further processing, raw pork contaminated with these food-associated pathogens should not be used for the production of uncooked smoked ham or bacon. It is concluded that *Staphylococcus* aureus were detected in ham (1.9 x 10^2 cfu/g) and bacon (1.8 x 10^6 cfu/g) as end-product.

**References**

