Risk Assessment: Abscessation of Head Lymph Nodes and Carcass Inspection at Two High-Line-Speed Beef Abattoirs in Western Canada

JOHN A. BRADLEY* and KLAUS W. F. JERICH0

1Agriculture and Agri-Food Canada, Food Production and Inspection Branch, Alberta Region, 220 4th Avenue S.E., Calgary, Alberta, T2G 4X3; and 2Agriculture Canada, Animal Diseases Research Institute, P.O. Box 640, Lethbridge, Alberta, Canada T1J 3Z4

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ABSTRACT

Canadian inspection procedures for railing out young beef heifer and steer carcasses in high-line-speed abattoirs because of head lymph node abscessation (HLNA) were evaluated. A total of 231,405 animals were inspected and 3,368 that had HLNA were railed out to a stationary line and subjected to further detailed examination. These were compared to 1,659 control carcasses lacking any visual abnormalities, including HLNA, in the judgment of inspection personnel. Four carcasses and 7 portions of carcasses with HLNA and 2 portions of control carcasses were condemned. Histopathological and limited bacteriological examinations were carried out. It was concluded that use of HLNA detection exclusively for more detailed carcass inspection was inefficient and lacked scientific validity. Other criteria are essential for the identification of carcasses that pose a significant hazard to human health.

Key words: Lymph node abscessation, risk assessment, inspection protocol

The Meat Inspection Act 1985 (4) and Meat Inspection Regulations 1990 (5) are legal instruments respecting matters relating to, among others, the inspection of meat in federally registered abattoirs in Canada. A Manual of Procedures (2) is published and updated as required, as an interpretive document outlining how compliance to the Act and Regulations can be achieved. It is primarily designed as a guide to inspection personnel. A detailed document has also been prepared to guide inspectors supervising beef-cattle slaughter in abattoirs operating at high-line speeds (1).

Using these guidelines, the head of each slaughtered animal is carefully examined for evidence of infectious or contagious disease or parasitic infestation. Any deviations from normal are made known to other inspectors on the line, to assist in making further judgments as to the disposition of edible offal and carcasses. Affected heads are frequently condemned, but retained for reference until the latter dispositions are completed. In the course of these examinations it has been the practice to incise the retropharyngeal, parotid, mandibular, and atlantal lymph nodes. Bacteria in any abscessed body lymph node may gain access to any localized or generalized body tissue via lymphatic drainage and blood flow. Head lymph nodes are by far the most commonly abscessed nodes in cattle from western Canada. Traditionally, when abscesses are noted, the corresponding carcass is easily accessible for incision and examination of the prescapular lymph nodes, to estimate infection spread and the need for additional detailed carcass examination.

In most abattoirs the line speed is such that one inspector can examine both heads and the corresponding prescapular carcass lymph nodes, if necessary. The technological development of high-line speeds (300 carcasses per h and more) makes this impossible. Incision of carcass lymph nodes and detailed carcass examination in these circumstances necessitates the removal of the carcasses to a stationary side line (carcass rail out). This frequently results in a slowing down of the production line and/or stoppages which are very costly to industry. It is important to examine the scientific validity of such practices, especially when they also have the potential to cause further inadvertent carcass contamination (3, 10). Proposed changes to existing protocol should undergo similar scrutiny.

In a 6-month study at one abattoir in western Canada, 1,490 of 140,524 carcasses were railed out following detection of head lymph node abscessation (HLNA), but only 7 carcasses were condemned (7). This low condemnation rate may be a consequence of the uniformly healthy status of young beef cattle produced in the region. It prompted us to review the practice of carcass rail-out at the two high-line-speed abattoirs in Alberta. The purpose of the study was to measure the prevalence of HLNA, and how macroscopically recognizable HLNA relates to carcass condemnations. Pathological and limited bacteriological studies were done in an effort to identify potential bacterial hazards in abscessed lymph nodes detected in these condemnations. Qualitative and quantitative considerations are necessary in
the evaluation of microbiological hazards in raw meats, as elsewhere, and exhaustive studies are extremely complex (9).

**MATERIALS AND METHODS**

A total of 231,405 grain-fed heifers and steers under 24 months slaughtered at two high-line-speed abattoirs between December 1991 and March 1992 were included in the study. Each animal was inspected as per the Meat Inspection Act 1985 (4), Regulations 1990 (5), and the Canadian Streamlined Inspection System, Steers and Heifers (1) manual. Incision of the atlantal lymph nodes was omitted, as per the latter guidelines. When HLNA's were recorded the corresponding carcass was railed out for further detailed inspection and disposition by a veterinary inspector. All lymph node abscesses and their locations were recorded; otherwise normal inspection practices were performed. Lymph nodes with calcified and neoplastic changes were not part of this study.

In addition to the above, on each slaughter day, 10 carcasses lacking observable abnormalities (including HLNA) were selected at random for similar detailed inspection. They were railed out approximately one per half hour by different inspectors, as the carcasses passed the on-line carcass inspection station. Altogether 1,659 control carcasses (839 in abattoir A and 820 in B) were subjected to veterinary inspection in this manner, to compare subsequent disposition with that of carcasses from animals with HLNA.

Company records provided information regarding the number of animals in each group or lot slaughtered on a particular day. These lot sizes were based on bills of lading provided by truck drivers. Where carcasses or portions of carcasses were condemned, tissue samples from abscessed carcass lymph nodes were submitted to the laboratory frozen and in 10% buffered formalin. The latter were processed to paraffin, sectioned at 5 μm and stained with hematoxylin and eosin for histopathological examination. For bacteriological study the frozen samples were thawed and immersed in alcohol and the alcohol ignited. A sterile scalpel was used to expose deep lymph node tissue, some of which was removed with sterile forceps. This tissue was used to inoculate blood agar and MacConkey plates for aerobic incubation and bacterial identification. Biochemical analysis was included to identify bacteria to the genus level.

Chi-square tests (15) were carried out to compare the incidence (or proportions) of HLNA's in control and test animals and in each abattoir. Condemnations of portions and whole carcasses were also compared using the chi-square test.

**RESULTS**

During the study period abattoir A slaughtered 133,432 of the subject animals and abattoir B slaughtered 97,973. In all, 3,368 or 1.46% (1.18% in A, 1.84% in B) had head lymph node abscesses and their corresponding carcasses were railed out. The frequency of abscessation in each lymph node in each abattoir is given in Table 1. Most cattle with HLNA had only one lymph node affected: 1,500 of a total of 1,570 in abattoir A and 1,604 of 1,798 in abattoir B. By the chi-square test, there was a significant difference between the proportions of cattle with HLNA in each abattoir (P < 0.001). Of the 231,405 cattle slaughtered, 219,855 (95.01%) were from lots of more than 10 animals on arrival. The average lot size was 86 and more than half (52.51%) of the lots were free from HLNA. Only 5.88% of the lots had 5% or more cattle affected with HLNA (Table 2).

Of the 3,368 carcasses railed out, 4 entire carcasses, 2 front quarters in 2 carcasses and 5 single quarters (3 fronts and 2 hinds) were condemned by veterinary inspectors. By the chi-square test, the differences between the proportion of condemned carcasses and between the proportion of condemned portions in the two plants were not significant (P > 0.05). All condemnations were based on the presence of regional or generalized lymphadenitis. Macroscopic post-mortem lesions characterizing clinical septicemia were not observed in any of the carcasses. Condemned carcasses were rated subjectively by the veterinary inspector on their weight and visible meat quality. On a scale of one (best) to 10 (poorest), all condemned carcasses rated one or two. Among the 1,659 control animals, 2 carcasses had abscessed prescapular lymph nodes and 1 front quarter was condemned. These results did not differ significantly (chi square test, P > 0.05) from the number of carcasses identified with lymph node abscesses as a result of HLNA rail out.

Histopathological examination determined the etiology of the changes in lymph nodes of 5 of 9 carcasses. In three cases colony formations and tissue changes indicative of infection with Actinobacillus spp. were evident and bacteriological corroboration was obtained. Pathological evidence of Actinobacillus spp. was present in both lymph nodes from the control carcasses, and the organism was isolated from one. Other potential pathogens were also isolated from the condemned carcasses: Staphylococcus spp. (other than aureus) from 5, Aeromonas spp. from 2, Enterobacter spp. from 2, Citrobacter spp. from 2, Staphylococcus aureus from 1 and Escherichia coli from 1. Samples were not submitted from 4 carcasses with 6 quarters (2 front quarters from each of 2 and 1 front quarter from each of 2) that were

**TABLE 1. Abscessation in head lymph nodes of 231,405 cattle**

<table>
<thead>
<tr>
<th>Abattoir</th>
<th>RRP</th>
<th>LRP</th>
<th>LSM</th>
<th>RSM</th>
<th>RPA</th>
<th>LPA</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>443</td>
<td>546</td>
<td>264</td>
<td>324</td>
<td>16</td>
<td>10</td>
</tr>
<tr>
<td>B</td>
<td>495</td>
<td>504</td>
<td>469</td>
<td>482</td>
<td>22</td>
<td>36</td>
</tr>
<tr>
<td>A and B</td>
<td>938</td>
<td>1050</td>
<td>733</td>
<td>806</td>
<td>38</td>
<td>46</td>
</tr>
</tbody>
</table>

* RRP, LRP: right and left retropharyngeal; LSM, RSM: right and left submaxillary; RPA, LPA: right and left parotid.

**TABLE 2. Head lymph node abscesses (HLNA) in lots of more than 10 cattle**

<table>
<thead>
<tr>
<th>Description of lots of &gt;10 cattle</th>
<th>No. in abattoirs A and B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total number of cattle</td>
<td>219,855</td>
</tr>
<tr>
<td>Total carcasses railed out</td>
<td>3,012</td>
</tr>
<tr>
<td>Total number of lots</td>
<td>2,552</td>
</tr>
<tr>
<td>Largest lot size</td>
<td>651</td>
</tr>
<tr>
<td>Average lot size</td>
<td>86</td>
</tr>
<tr>
<td>Lots without HLNA</td>
<td>1,340 (52.5%)</td>
</tr>
<tr>
<td>Lots with &gt;5% HLNA</td>
<td>1,062 (41.6%)</td>
</tr>
<tr>
<td>Lots with 6–15% HLNA</td>
<td>150 (5.9%)</td>
</tr>
</tbody>
</table>
condemned because of abscessation of regional lymph nodes.

**DISCUSSION**

A generally accepted definition of food safety (8) includes the clauses “will not cause food-borne infection or intoxication when properly handled and prepared with respect to its intended use” and “has been produced under adequate hygiene control.” This definition tacitly acknowledges the impossibility of guaranteeing freedom from all pathological agents in improperly handled raw meat products. The purpose of this study of young beef heifers and steers in high-line-speed abattoirs was to examine how effective the HLNA rail-out procedure was in removing potential food-borne hazards.

The significant difference in incidence of HLNA between abattoirs A and B was not subjected to further examination in this study, but it could have been related to the source of supply of the slaughter cattle.

Condemnations of carcasses or portions of carcasses were based on experienced but subjective assessments of veterinary inspectors. Differences of opinion occur within the scientific community as to whether lymphadenitis macroscopically confined to regional lymph nodes, but evident in more than one location throughout the carcass, is satisfactory evidence for total or partial condemnations. Six of the seven participating veterinarians acknowledged that the evidence for the condemnations in this study was tenuous at best, and largely based on prudence.

Abscesses in prescapular lymph nodes of carcasses of 2 control animals were not associated with HLNA, and there was no significant difference between the proportions of portions condemned in the control animals versus those railed for HLNA. The presence of a (prefemoral) lymph node abscess in one hindquarter of each of 2 railed-out carcasses could not be associated with any confidence with the same infection that resulted in HLNA in the same animals, since there was no evidence of generalized lymphadenitis. Because of their inaccessibility, many carcass lymph nodes are not examined routinely and unusually large or abscessed lymph nodes exposed during processing (cutting, boning, boxing, etc.) are usually removed from the edible-food chain, though some could be inadvertently included in boneless beef. Cheek meat is not harvested from animals with HLNA; the heads go immediately to inedible rendering. Without corroborating evidence to suggest more serious consequences, localized infection in lymph nodes is comparable to abscession in any other body location and may be removed without contemplating carcass condemnation. In the cases reported here, the condemned carcasses were of good flesh and grade.

Some bacteria potentially pathogenic to humans were isolated from submitted lymph nodes. *Staphylococcus aureus* is a facultative anaerobe which does not multiply or produce toxins at refrigeration temperatures. Control of this and other pathogenic organisms on meat products depends on good sanitary practices designed to minimize contamination (12), and subsequent proper handling and preparation for consumption. There is one report of a human fatality due to *Actinobacillus lignieresi*, but it was not related to meat consumption (6). The organism is not considered a significant public health risk (12). All of the bacteria identified here were also isolated in a separate study of 36 apparently normal carcass lymph nodes submitted by abattoir B (13) and have been isolated repeatedly from portions of untreated raw meat (14). Pathogenic and nonpathogenic organisms have also been found in a general survey of lymphoreticular lesions in beef cattle in Ontario (11). These findings pose a singular problem to authorities who would advocate zero tolerance for potential pathogens in fresh meat.

The purpose of raiing out carcasses which had HLNA was to subject them to more detailed, macroscopic visual inspection. This inspection only identified some carcasses with lymph node abscessation of a localized nature. The bacteria associated with these lymph nodes were those that could be isolated routinely from the lymph nodes of similar slaughter cattle in the region and were not isolated as a direct consequence of HLNA identification. Furthermore, incision of carcass lymph nodes during inspection is invasive and liable to cause unnecessary contamination. The presence of human pathogens on raw meat products and the associated human safety risks are of concern, but their elimination will not be influenced in any significant way by the described HLNA rail-out procedures.

This study suggests that other methods should be employed to identify carcasses requiring condemnation. Resulting economies could be more productively directed to hazard analysis critical control point systems. It should be emphasized that this study focused on the decision for rail out and further detailed inspection of carcasses of young fed cattle of a uniform health status, based purely on the presence of HLNA. For this reason, and due to the difficulties encountered in carrying out studies in an industrial environment, further studies are required to make judgments relating to other classes of cattle or similar cattle elsewhere.

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**REFERENCES**