# Frequencies of Injection-Site Lesions in Muscles From Rounds of Dairy and Beef Cow Carcasses*

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**SUMMARY**

Frequency of injection-site lesions in muscles from top sirloins and rounds in fed cattle carcasses is well documented; this study characterizes frequency and severity of lesions in muscles from rounds of beef and dairy cow carcasses. Audits were conducted in 1998, 1999, and 2000 on 3,190 rounds from cow carcasses. Outside round muscles were cut into 0.5 in slices to characterize lesions. In 1998, 31% of beef rounds and 60% of dairy rounds had an injection-site lesion. Frequency of lesions in beef rounds significantly declined 5 percentage points between 1998 and 1999 and 6 percentage points between 1999 and 2000. Frequency of lesions in dairy rounds significantly declined 9 percentage points between 1998 and 1999 and 16 percentage points between 1999 and 2000. Frequencies of injection-site lesions in muscles of beef rounds were significantly lower than those in muscles of dairy rounds in all three years. Although yearly data indicate trends in declining frequencies of injection-site lesions, there remain needs for educational programs and continued improvements in beef quality assurance practices among both beef and dairy producers.

**Key Words**: Injection-site Lesions, Cow Carcasses

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## INTRODUCTION

Results of the National Market Cow and Bull Beef Quality Audit—1999 (NMCBBQA—99) revealed (Roeber et al., 2000a) that approximately 44% of product from carcasses of market cows and bulls is sold as whole muscle cuts (as 100% visual lean pieces or as primal cuts). The presence of injection-site lesions in whole muscle cuts, such as the top sirloin and outside round, limits their use and value. Roeber et al. (2001a) reported that, in NMCBBQA—99, "occurrence of injection-site lesions in muscles" was included among the top five quality challenges for both beef and dairy market cows and bulls. The NMCBBQA—99 and the National Non-Fed Beef Quality Audit—1994 (NNFBQA—94), respectively, attributed losses of $1.46 and $0.66 for each market cow or bull harvested in those years to the occurrence of injection-site lesions (Roeber et al., 2000a). Because injection-site lesions are concealed in muscles and/or are under subcutaneous fat, they are seldom found during fabrication at the packing plant and appear instead during wholesale/retail fabrication or at the consumer level.

The frequency of injection-site lesions in muscles from top sirloins and outside rounds in carcasses from fed cattle is well documented (Dexter et al., 1994; George et al., 1995b; Roeber et al., 2001b; Van Donkersgoed et al., 1999). The objective of the current study was to characterize the frequency and severity of lesions in muscles from outside rounds of beef and dairy cow carcasses. Monitoring of the frequency of injection-site lesions in muscles from outside rounds of beef cow and dairy cow carcasses allows educational efforts of state and national beef quality assurance (BQA) programs to target, more definitively, management practices of producers that can be changed to minimize occurrence of such defects.

## MATERIALS AND METHODS

To obtain estimates of the frequency and severity of injection-site lesions in muscles of outside rounds from beef and dairy cow carcasses, data were collected in each of four packing plants in 1998 and in each of seven packing plants in both 1999 and 2000. Packing plants in which to conduct audits were selected by geographic location and daily harvest/fabrication capacity. Among packing plants, it was believed that carcasses represented cows from small, medium, and large beef and dairy enterprises.

At each packing plant, 200 outside rounds (*biceps femoris* plus *semitendinosus* muscles) were randomly selected except that selections ensured that outside rounds were included from both dairy cow and beef cow carcasses during each collection period. Each muscle from each outside round was cut into .5-in slices from the cranial to caudal ends and evaluated for lesions by a trained researcher. Lesions were documented by location, depth from the outside of the muscle, and diameter of the lesion. Lesion location was recorded by the muscle (*biceps femoris* or *semitendinosus*) and the region or quadrant (Figure 1) in which it was present. The quadrants were identified as Q1 through Q4. Quadrant Q4 was located at the cranial (or proximal) end of the primal cut (outside round) and contained only the *biceps femoris* muscle. The remaining three quadrants Q1, Q2, and Q3 were defined as even thirds of the remaining primal cut (containing both the *biceps femoris* and *semitendinosus* muscles) with Q3 adjacent to Q4, and with Q1 being the most caudal (or distal) third, at the shank end. Lesion depth was measured from the outside surface of the muscle (fat cover excluded) to the center of the lesion. Lesion diameter was equivalent to the length of the lesion through the primal cut; similar to documenting the number of steaks the lesion affected. The damaged tissue was classified (gross evaluation) into one of five lesion types using the 5-point system originally described by Dexter et al. (1994).

***Statistical Analysis***

The frequency of injection-site lesions, as percentages, was analyzed using the Frequency Procedure of SAS (SAS Inst., Cary, NC). Differences between frequency percentages for years (1998, 1999, 2000) and for muscles from beef cow vs. dairy cow carcasses were determined by calculating the chi-square statistic. Analyses of variance for number of lesions per round, lesion depth, and lesion diameter for audit period and breed type (beef or dairy) were conducted using the general linear models procedures of SAS (1999). Least significant differences were used to identify statistical differences among mean values for number of lesions per round, and lesion depth and diameter when AOV demonstrated effects ($\alpha = 0.05$) for audit period or the origin (beef vs. dairy) of muscle.

## RESULTS AND DISCUSSION

For all three years of these audits, frequencies of injection-site lesions and average number of lesions per round that had a lesion were higher ($P < 0.05$) in outside round muscles from dairy carcasses as compared to beef carcasses (Table 1). This result was not unexpected because at the NMCBBQA Strategy Workshop in 1999, it was estimated that dairy cows receive several more injections per year than do beef cows (Roeber et al., 2000a).

Across the three years of audits, injection-site lesions in outside round muscles from beef cow carcasses and dairy cow carcasses were 26% and 49%, respectively. An estimate of 33 to 35% frequency of injection-site lesions in muscles from outside rounds from cow and bull carcasses in Canada reported by Van Donkersgoed et al. (1998, 1999) is within the range (26 to 49%) of the current study.

The frequency of injection-site lesions in muscles from beef rounds declined 5 percentage points (from 31% to 26%) from 1998 to 1999 and an additional 6 percentage points (from 26% to 20%) from 1999 to 2000 ($P < 0.05$, Table 1). The frequency of injection-site lesions in muscles from dairy rounds declined 9 percentage points (from 60%, to 51%) from 1998 to 1999 and an additional 16 percentage points (from 51%, to 35%) from 1999 to 2000 ($P < 0.05$, Table 1). In 1998, 1999, and 2000, the frequency of injection-site lesions was greater ($P < 0.05$) in muscles from dairy rounds than in those from beef rounds. While there was no difference in the average number of lesions in those muscles that had a lesion present among years studied, in muscles within either breed type, muscles from beef rounds had fewer ($P < 0.05$) lesions per round than did muscles from dairy rounds in all three years (Table 1).

Identification of locations within the outside round muscles at which injection-site lesions occurred should be useful to educators as they design programs to assist cattle producers in reducing the occurrence of this defect in market cow and bull carcasses. Injection-site lesions occurred more frequently ($P < 0.05$) in the *semimembranosus* muscles and in caudal quadrants (Q1 and Q2) in rounds from dairy cow carcasses than in those from beef cow carcasses, suggesting that more dairy cattle than beef cattle are given injections from behind, and may be administered while the animals are restrained in self-locking head restraints in the feeding area or perhaps in the milking parlor. The location at which most ($P < 0.05$) of the injections are administered to beef cattle appears to be between the hooks and the pins (Q3 and Q4), likely from above while cattle are handled through a chute.

The kind of lesion is useful in characterizing the length of time between administration of the injection and the time of harvest (George et al., 1995b; George et al., 1995a; Dexter et al., 1994). Clear lesions and woody calluses are typical of injections given to animals in earlier stages of their life (as calves or at times before weaning), metallic and nodular lesions are typical of pharmaceuticals administered to cattle mid-to-late feeding phases, and cystic lesions are typical of injections given to cattle late in the finishing phase (George et al., 1995b; George et al., 1995a; Dexter et al., 1994). In 1998, 1999, and 2000, in muscles of rounds from both beef cow and dairy cow carcasses, the frequencies of both clear lesions and woody lesions were greater ($P < 0.05$) than the frequencies of nodular, metallic, and cystic lesions (data not presented in tabular form). In muscles of rounds from beef and dairy cow carcasses, the frequencies of cystic lesions were not statistically different from 1998 to 1999 or from 1998 to 2000, indicating that two to five percent of cows likely received intramuscular injections near the time of harvest. In the most recent audit of fed steer and heifer carcasses, frequencies of cystic lesions in top sirloin butts and rounds were only 0.24% and 0.0% of total lesions, respectively (Roeber et al., 2000b).

Depth and diameter of injection-site lesions were recorded and used for prediction of relative amounts of saleable product lost as a result of the lesion (data not presented in tabular form). Diameters of lesions varied among the kind of lesions in muscles of beef and dairy cow rounds. Cystic lesions, in muscles of dairy rounds, damaged more saleable product ($P < 0.05$) per lesion than did clear, metallic, nodular, and woody lesions. In beef rounds, the diameter of cystic lesions was similar to that of nodular lesions, but larger than that of the other kinds of lesions (data not presented in tabular form). Lesions were closer ($P < 0.05$) to the outside surface of the muscles of the round in beef and dairy carcasses in 1999 as compared to 1998 and closer ($P < 0.05$) to the surface in 2000 as compared to 1999 (data not presented in tabular form). There was no apparent difference ($P > 0.05$) in the diameter of the lesions in the muscles of beef cow rounds in 1998, 1999, and 2000 (data not presented in tabular form).

## IMPLICATIONS

The frequency of injection-site lesions in muscles of the round from

beef and dairy cow carcasses declined by 11 and 25 percentage points, respectively, from 1998 to 2000. These reductions in the frequency of injection-site lesions are substantial but not sufficient because one of five beef cattle rounds and more than one of three of dairy cattle rounds still have injection-site lesions. Injection-site lesions in beef and dairy rounds cost beef and dairy industries, in total, over $9 million annually (Roeber et al., 2000a). Additionally, the most recent National Animal Health Monitoring System report indicated that 47% of producers and 37% of veterinarians administer intramuscular injections in the upper or lower rear leg of cows (USDA, 1998) so the need for further educational effort is apparent. Continuous monitoring of the frequency of injection-site lesions in muscles of the round from beef and dairy cow carcasses allows educational efforts of state and national quality assurance programs to target, more definitively, management practices of producers that can minimize occurrence of such defects in end-products.

## LITERATURE CITED


Dexter, D.R., G.L. Cowman, J.B. Morgan, R.P. Clayton, J.D. Tatum, J.N. Sofos, G.R. Schmidt, R.D. Glock, and G.C. Smith. 1994. Frequency of injection-site lesions in beef top sirloin butts. J. Anim. Sci. 72:824-827.

George, M.H., P.E. Heinrich, D.R. Dexter, J.B. Morgan, K.G. Odde, R.D. Glock, J.D. Tatum, G.L. Cowman, and G.C. Smith. 1995a. Injection-site lesions in carcasses of cattle receiving injections at branding and at weaning. J. Anim. Sci. 73:3235-3240.

George, M.H., J.B. Morgan, R.D. Glock, J.D. Tatum, G.R. Schmidt, J.N. Sofos, G.L. Cowman, and G.C. Smith. 1995b. Injection-site lesions: Frequency, tissue histology, collagen concentration, and muscle tenderness in beef rounds. J. Anim. Sci. 73:3510-3518.

Roeber, D.L., K.E. Belk, G.C. Smith, J.D. Tatum, T.G. Field, J.A. Scanga, C.D. Smith, P.D. Mies, H.A. Foster, T.K. Kennedy, B.R. Moore, and S.G. Hodge. 2000a. The Final Report of the National Market Cow and Bull Beef Quality Audit—1999; submitted to the National Cattlemen's Beef Association, Englewood, CO. Meat Science Program, Department of Animal Sciences, Colorado State University, Fort Collins, CO.

Roeber, D.L., G.C. Smith, R.C. Cannell, J.A. Scanga, K.E. Belk, J.D. Tatum, and J.N. Sofos. 2000b. Beef Quality Assurance Audits: Incidence of injection-site damage in top sirloin butts and in muscles of the round – October, 1999 through September, 2000. The Final Report of the Injection-Site Lesion Audits, submitted to the National Cattlemen's Beef Association, Englewood, CO. Center for Red Meat Safety, Department of Animal Sciences, Colorado State University, Fort Collins, CO.

Roeber, D.L., P.D. Mies, C.D. Smith, K.E. Belk, T.G. Field, J.D. Tatum, J.A. Scanga, and G.C. Smith. 2001a. National Market Cow and Bull Beef Quality Audit—1999: A survey of producer-related defects in market cows and bulls. J. Anim. Sci. 79:658-665.

Roeber, D.L., R.C. Cannell, K.E. Belk, J.A. Scanga, G.L. Cowman, and G.C. Smith. 2001b. Frequency of injection-site lesions in beef top sirloin butts. J. Anim. Sci. 79:2615-2618.

USDA. 1998. National Animal Health Monitoring System. Part IV: Changes in the U.S. Beef Cow-Calf Industry, 1993-1997. Animal and Plant Health Inspection Service, Veterinary Services, USDA. Washington, DC. pp 37-40.

Van Donkersgoed, J., S. Dixon, and M. Vanderkop. 1998. Injection site surveys in Canadian yearling cattle and cull cows and bulls: Fall 1997. Can. Vet. J. 39:497-499.

Van Donkersgoed, J., S. Dixon, and M. Vanderkop. 1999. Monitoring injection site lesions in Canadian yearling cattle and cull cows and bulls: Spring 1998. Can. Vet. J. 40:579-580.


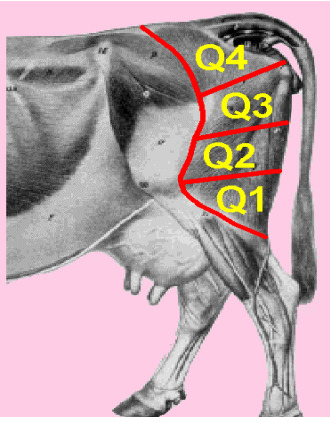


**Figure 1.** Quadrants of the hindquarter in which injection-site lesions were identified. Quadrant Q4 is located at the cranial (or proximal) end of the primal cut (outside round) and contains only the *biceps femoris* muscle. The remaining three quadrants Q1, Q2, and Q3 were defined as even thirds of the remaining primal cut (containing both the *biceps femoris* and *semitendinosus* muscles) with Q3 adjacent to Q4, and with Q1 being the most caudal (or distal) third, at the shank end.

Table 1. Frequency of injection-site lesions in 1998, 1999, and 2000.

| | Beef type | | | Dairy type | | |
|---|---|---|---|---|---|---|
| | 1998 | 1999 | 2000 | 1998 | 1999 | 2000 |
| Total pieces audited | 135 | 824 | 736 | 243 | 586 | 666 |
| Pieces with lesion(s) | 42 | 212 | 147 | 146 | 299 | 230 |
| Percent of rounds with lesion(s) | $31^{a,y}$ | $26^{b,y}$ | $20^{c,y}$ | $60^{a,x}$ | $51^{b,x}$ | $35^{c,x}$ |
| Number of lesions per piece that had a lesion (Mean ± S.E.) | $1.2^{y} \pm 0.5$ | $1.2^{y} \pm 0.5$ | $1.4^{y} \pm 0.8$ | $1.6^{x} \pm 1.3$ | $1.6^{x} \pm 1.2$ | $1.7^{x} \pm 1.2$ |
| Maximum lesions in one round | 3 | 4 | 6 | 11 | 12 | 8 |

[a,b,c] Subcolumn percentages, within each breed type and comparing years, with differing superscript letters differ ($P < 0.05$).
[x,y] Subcolumn percentages, within each year and comparing breed type, with differing superscript letters differ ($P < 0.05$).

Table 2. Injection-site lesion frequency data, by location within the outside round muscles, for all plants in 1998, 1999, and 2000, as a percentage of total lesions.

| | Beef type | | | Dairy type | | |
|---|---|---|---|---|---|---|
| Location[1] in outside round muscles | 1998, % | 1999, % | 2000, % | 1998, % | 1999, % | 2000, % |
| *Semitendinosus* Q1(shank end ) | $6^{a,x}$ | $0^{b,y}$ | $9^{a,x}$ | $11^{ab,x}$ | $15^{a,x}$ | $10^{b,x}$ |
| *Semitendinosus* Q2 | $7^{ab,x}$ | $5^{b,y}$ | $14^{a,y}$ | $15^{b,x}$ | $24^{a,x}$ | $17^{b,x}$ |
| *Semitendinosus* Q3 | $14^{a,x}$ | $10^{a,x}$ | $3^{b,y}$ | $14^{a,x}$ | $11^{ab,x}$ | $7^{b,x}$ |
| *Semitendinosus* all quadrants | $27^{a,x}$ | $15^{b,y}$ | $27^{a,x}$ | $40^{b,x}$ | $50^{a,x}$ | $34^{b,x}$ |
| *Biceps femoris Q1 (shank end)* | $1^{b,x}$ | $2^{b,y}$ | $6^{a,x}$ | $8^{b,x}$ | $13^{a,x}$ | $10^{ab,x}$ |
| *Biceps femoris Q2* | $12^{ab,x}$ | $8^{b,x}$ | $18^{a,y}$ | $18^{b,x}$ | $16^{b,x}$ | $31^{a,x}$ |
| *Biceps femoris* Q3 | $22^{a,x}$ | $21^{a,x}$ | $10^{b,y}$ | $22^{a,x}$ | $13^{b,y}$ | $17^{ab,x}$ |
| *Biceps femoris* Q4 (sirloin end) | $38^{b,x}$ | $53^{a,x}$ | $38^{b,x}$ | $13^{a,y}$ | $8^{a,y}$ | $9^{a,y}$ |
| *Biceps femoris* all quadrants | $73^{b,x}$ | $85^{a,x}$ | $73^{b,x}$ | $60^{a,x}$ | $51^{b,y}$ | $66^{a,x}$ |

[1] Locations included two muscles and four quadrants (Q1 to Q4, Figure 1) in outside rounds of carcasses.
[a,b,c] Subcolumn percentages, within each breed type and comparing years, with differing superscript letters differ ($P < 0.05$).
[x,y] Subcolumn percentages, within each year and comparing breed types, with differing superscript letters differ ($P < 0.05$).