Incidence of Injection-Site Lesions in Fed Beef Top-Sirloin Butts and Rounds[1]

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SUMMARY

Damaged beef muscle tissue resulting from intramuscular injections of animal-health products represents a "quality-control" problem and economic losses to the beef industry. Fifteen individual and sequential audits of injection-site lesions in beef top-sirloin butts have been conducted at the steak provisioner/cutting level between November 1995 and July 2000. The incidence of injection-site lesions in top-sirloin butts (n = 240,080) decreased ($P < 0.05$) between November 1995 (11.4%) and July 2000 (2.1%). Results of these audits indicate that producers have changed injection practices in response to efforts of the national/state quality assurance programs. Analyses of results for lesion classes suggested that the majority of lesions were induced at times which coincide with cow-calf, stocker, or early finishing-period stages of cattle production.

Key Words: Injection, Lesions, Top Sirloin Butts, Tissue Damage, Incidence

INTRODUCTION

Results of the National Beef Quality Audit–1995 (Smith et al., 1995) revealed that 30-40% of purveyors, retailers, and packers believed the frequency of injection-site lesions had decreased since a similar audit in 1991. Even with such improvement, purveyors and retailers still ranked this defect in the top ten challenges of fed steers and heifers. Pharmaceuticals are commonly administered to cattle at various stages of their lives (Taylor and Field, 1999). If injections are given intramuscularly, in the anatomical region between the hooks and pins, tissue damage occurs (Dexter et al., 1992). Injection-site lesions are seldom detected at packing plants because damage is concealed within the muscles and subcutaneous fat. Unless top sirloin butts are further processed by packers (including removal of subcutaneous fat and separation of the *biceps femoris* from the *gluteus medius*), injection-site damage will normally be exposed at retailer or purveyor establishments during portioning of the primal cuts. Dexter et al. (1994) reported that activities of the National Cattlemen's Beef Association Quality Assurance Advisory Board led to a reduction in the incidence of injection-site lesions from 21.3% (July 1991) to 10.9% (March 1993). George et al. (1996) reported that continuation of these efforts did not result in a reduction in injection-site lesion incidence from July 1993 (10.9%) to July 1995 (10.2%). Since July 1995, 15 audits have been conducted to determine the impact of beef quality assurance efforts of cattlemen's organizations on the incidence of injection-site lesions in the top sirloin butts of fed steers/heifers. This report is a sequel to those by Dexter et al. (1994) and George et al. (1996) and continues the reporting of results of national audits of incidence of injection-site lesions in top sirloin butts from fed steers/heifers using data collected from November 1995-July 2000 and reports the incidence of injection-site damage in muscles of the round from fed steers/heifers during 2000.

MATERIALS AND METHODS

General Protocol. In order to obtain ongoing assessments of the incidence/severity of injection-site lesions in top sirloin butts on a national scale, data were collected from individual steak-cutting plants located nationwide. Audits in each of four plants were conducted in November 1995; in each of March, July, and November of 1996, 1997, 1998, and 1999; and in March and July of 2000. Facilities audited were selected according to (1) U.S. geographic location and (2) quantities of top sirloin butts processed at that location. In order to ensure that adequate quantities of top sirloin butts were evaluated, two shifts (8-9 h) were audited at each plant visited during each audit period. Audit procedures were identical to those described by Dexter et al. (1994).

At each of the audited facilities, all steak cutters were provided verbal instructions concerning the audit process and were shown how the affected tissue (injection-site lesion) appeared in top sirloin butts/steaks. Instructions also were provided regarding actions to take when questionable tissue was discovered, with the proper course of action being to hold the product for evaluation by the investigator before excision of the tissue. As each individual top sirloin butt was portioned into individual steaks, injection-site damage that was exposed was excised from all affected steaks. The excised damaged tissue was subsequently classified using a 5-point classification system as described by Dexter et al. (1994) and weighed (to the nearest oz).

Statistical Analysis. Data representing percentage incidence of injection-site lesions were analyzed using the Frequency Procedure of SAS (SAS, 1998). Differences between incidence values associated with the 15 audit time periods were determined by calculating the chi-square statistic. Means for lesion weight were computed and analysis of variance was conducted using the GLM procedures of SAS (1998). Least significant differences were used to identify statistical differences among mean lesion weights when AOV demonstrated an effect of the audit period and/or lesion type ($\alpha = 0.05$).

RESULTS AND APPLICATION

The average incidence of injection-site lesions during the audit period of November 1995 was 11.40%, which was higher numerically than the 10.19% incidence reported by George et al. (1996) for the audit period of July 1995. The average weight of injection-site lesions excised from affected top sirloin butts during the November 1995 audit was 6.7 oz, which also was numerically higher than the 5.3 oz lesion weight found in July 1995 (George et al., 1995).

Over the entire 15 audit periods included in this report, incidence of injection site lesions decreased (Table 1) from a high of 11.40% in the first audit period (November 1995) to a low of 2.06% in the last audit period (July

[1] This project was funded by the Cattlemen's Beef Board and the National Cattlemen's Beef Association.
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2000). The decline in numerical injection-site lesion incidence was continuous, with each subsequent incidence lower ($P < 0.05$) than the preceding audit incidence, over the 15 audit periods with the exception of: (a) the July 1996 to November 1996 audit periods, where the incidence did not change, (b) the July 1997 to November 1997 audit periods, where the incidence did not change, (c) the March 1998 to July 1998 to November 1998 audit periods, where incidence of injection site lesions peaked ($P < 0.05$) for one audit period and then returned to previous levels in the following audit period, (d) the November 1998 to March 1999 audit periods, where the incidence did not change, and (e) the November 1999 to March 2000 audit periods, where the incidence did not change. The incidence of injection-site lesions in fed steer and heifer top sirloin butts was lower than incidences reported by Van Donkersgoed et al. (1997 and 1998); in those two studies, the incidences of lesions in Canadian fed beef top sirloin butts were 18.8% and 13.3% in the fall of 1996 and in the spring of 1997, respectively. Reduced incidence of injection-site lesions from November 1995 to July 2000 correspond to the downward trend reported by Dexter et al. (1994); in that study, lesion incidence declined over the six audit periods between July 1991 to March 1993. During the period covered by the report of George et al. (1996), no decrease in injection-site lesion incidence occurred over seven audit periods from July 1993 to July 1995. Across the entirety of the period covered by successive reports of Dexter et al. (1994), then George et al. (1996) and now this study, the decrease in incidence of injection site lesions has decreased by 19.2 percentage points suggesting that producers have changed injection practices. The change in management practices could be, in part, the response to efforts of the National Cattlemen's Beef Association and state beef quality assurance programs. Those efforts have increased awareness of the problem and resulted in revised production practices (e.g., moving injection-sites to the neck region), and thus have resulted in reduced incidence of lesions in top sirloin butts caused by intramuscular injections.

Even with such decline of incidence in top sirloin butts in past years, the beef industry must remain cautious and the education must continue to develop as the incidence of injection-site lesions in fed steer and heifer rounds was 11.3% in the 2000 audit ($n = 7,436$). Results of the July/September 2000 Audit of round muscles from slaughter steers/heifers revealed an average trim per lesion of 12.5 ounces and no (0.0%) incidence of active fluid-filled lesions among the total lesions encountered. Reduction in incidence of injection-site lesions in muscles of the round from slaughter steers/heifers trended downward from 1995 (11.6%), to 1997 (4.4%). Unfortunately, the incidence of injection-site lesions increased in 1998 to levels comparable to those found in 1996, and increased again in 2000 to levels comparable to those found in 1995. Also increasing in the 1998 Audit was the percentage of total lesions found to be cystic (1.0%)—to the highest level yet observed in rounds from fed steers and heifers—suggesting that more of the injections monitored through auditing in 1998 had been administered during a period closer to the time of slaughter. Unfortunately, in the 2000 Audit, the incidence of lesions was 11.3%, an increase of 6.2 percentage points from 1999 and the average trim increased 2.5 oz per lesion (from 10.0 ounces, to 12.5 ounces).

Average weight of trim per lesion (Table 1) resulting from the presence of injection-site lesions generally increased from 6.7 oz in November 1995 to a peak in July 1997 of 15.3 oz; mean trim loss has sporadically declined since July 1997 and was 8.7 oz in July 2000. The increase in weight of injection-site lesion trim between November 1995 and July 2000 was not consistent with the findings of Dexter et al. (1994), who found that mean weight of trim loss per lesion declined from July 1991 to March 1993, but was consistent with the findings of George et al. (1996) who found that mean lesion trim weight increased from July 1993 to July 1995. The spike in mean lesion excision weights in 1997 coincide with the report of George et al. (1996) demonstrating toughening of muscle up to 3 in away from the core of injection-site lesions and suggests that a short-term change in excision procedures for lesions may have been initiated by purveyors.

Over the entire 15 audit period (November 1995 to July 2000), incidence of lesions classified as "cystic" (encapsulated lesion containing fluid) and "woody callus" (older lesion that is characterized by infiltration with organized connective tissue and fat) did not change ($P > 0.05$; Table 2). Incidence of lesions classified as "nodular" (lesion with nodules, the central foci of necrosis, surrounded by granulomatous inflammation) and "mineralized" (lesion containing mineralized remnants of muscle cells) decreased ($P < 0.05$), while the incidence of lesions classified as "clear" (older lesion that primarily contains clear connective tissue) increased ($P < 0.05$). Overall, 84% of the lesions examined between November 1995 and July 2000 were classified as "older" lesions (either "woody callus" or "clear").

Mean lesion weight by type and audit period are presented in Table 3. The mass of tissue surrounding injection-site lesions that was excised by purveyors during portioning increased ($P < 0.05$) from November 1995 through July 2000 for "clear" and "woody callus" lesions but not for other classes of lesions. Mean weights of "cystic", "nodular", and "mineralized" lesions did not increase when comparing audits of November 1995 vs. July 2000, but excised weights of "nodular" lesions increased ($P < 0.05$) to a peak value of 16.5 oz in July 1997 and weights of excised "mineralized" lesions increased ($P < 0.05$) to a peak value of 16.9 oz in November 1998.

IMPLICATIONS

Injection-site lesions have caused enormous economic loss to the U.S. beef industry and have been a serious quality assurance problem. Reductions in lesion incidence in top sirloin butts from U.S. fed steer and heifers for the period of November 1995 through July 2000 -- from 11.4% to 2.1%, respectively, -- generated an approximate net savings of $2.15 per steer or heifer slaughtered, which equates to an industry-wide savings of $76,078,100, based on the projected 30.31 million steers and heifers to be harvested in 2000.

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Table 1. Summary of injection-site damage (incidence and weight of lesions) in beef top sirloin butts for fifteen audits.

Audit Period	Number of Subrimals Evaluated	Incidence of Lesions[a] (%)	Average weight[b] of trim per lesion ± SE (oz)
November 1995	19,814	11.40[c]	6.7[i] ± .1
March 1996	19,935	10.29[d]	7.4[h] ± .1
July 1996	19,197	8.51[e]	7.4[h] ± .1
November 1996	21,617	9.03[e]	8.1[g] ± .1
March 1997	19,065	7.48[f]	8.0[g] ± .1
July 1997	11,088	5.61[g]	15.3[c] ± .5
November 1997	14,644	5.59[g]	10.0[d] ± .3
March 1998	12,927	4.75[h]	5.6[j] ± .3
July 1998	8,693	6.07[g]	8.0[g] ± .2
November 1998	8,044	4.43[h]	7.0[hi] ± .2
March 1999	16,237	4.64[h]	9.7[de] ± .2
July 1999	16,466	3.40[i]	7.4[hi] ± .2
November 1999	10,772	2.67[j]	9.2[ef] ± .3
March 2000	21,126	3.02[j]	8.0[g] ± .3
July 2000	20,455	2.06[k]	8.7[f] ± .3

[a] Percentage of top sirloin butts that had an injection-site lesion.
[b] Average weight per lesion after excision.
[c,d,e,f,g,h,I,,j,k] Values, within a column, lacking a common superscript letter differ ($P < 0.05$).

Table 2. Percentage incidence (of lesions excised) of injection-site lesions stratified by five types of lesion classification.

Audit Period	Lesion Classification[a]				
	Cysti	Nodular	Mineralized	Clear	Woody Callus
November 1995	0.75^{cde}	28.34^{b}	0.13^{cd}	46.06^{gh}	24.71^{h}
March 1996	0.59^{cde}	17.02^{d}	0.00^{d}	49.39^{fg}	33.01^{de}
July 1996	0.31^{e}	25.95^{b}	0.00^{d}	43.64^{h}	30.11^{ef}
November 1996	0.56^{cde}	25.87^{b}	0.51^{b}	45.44^{gh}	27.61^{fg}
March 1997	0.35^{de}	19.20^{c}	0.49^{b}	53.33^{e}	26.63^{gh}
July 1997	1.13^{bc}	21.86^{c}	0.48^{bc}	49.84^{efg}	26.69^{fgh}
November 1997	0.73^{cde}	16.85^{d}	0.85^{b}	45.79^{gh}	35.78^{cd}
March 1998	2.61^{b}	12.87^{de}	0.65^{b}	52.77^{ef}	31.11^{def}
July 1998	0.57^{cde}	11.17^{ef}	0.76^{b}	49.62^{efg}	37.88^{bc}
November 1998	1.40^{bc}	14.89^{de}	0.84^{b}	57.58^{c}	25.28^{gh}
March 1999	0.93^{cd}	9.15^{fg}	0.00^{d}	49.34^{fg}	40.58^{bc}
July 1999	0.36^{cde}	7.14^{gh}	0.00^{d}	48.93^{fg}	43.57^{b}
November 1999	0.69^{cde}	4.51^{hi}	0.00^{d}	53.82^{d}	40.97^{bc}
March 2000	0.47^{cde}	5.64^{hi}	0.31^{bc}	54.08^{c}	39.50^{bc}
July 2000	0.24^{e}	4.03^{i}	0.00^{d}	72.75^{b}	22.99^{h}

[a] Cystic = Encapsulated lesion containing fluid; Nodular = Lesion with nodules, the central foci of necrosis, surrounded by granulomatous inflammation; Mineralized = Lesion that contains mineralized remnants of muscle cells; Clear = Older lesion that contains primarily clear connective tissue.; Woody Callus = Older lesion characterized by infiltration with organized connective tissue and fat.
[b,c,d,e,f,g,h,I] Percentages, within a column, lacking a common superscript letter differ ($P < 0.05$).

Table 3. Mean (± SE) weight (oz) per injection-site lesion stratified by five types of lesion classification.

Audit Period	Lesion Classification[a]				
	Cystic	Nodular	Mineralized	Clear	Woody Callus
November 1995	12.1^{bc} ± 1.9	5.1^{fg} ± .1	3.3^{de} ± .9	4.1^{k} ± .1	7.8^{fg} ±.3
March 1996	12.6^{bc} ± 2.7	6.2^{f} ± .2	-	5.0^{ij} ± .1	7.6^{g} ± .3
July 1996	9.3^{c} ± 3.7	5.9^{fg} ± .2	-	5.2^{hij} ± .1	7.8^{fg} ± .3
November 1996	10.2^{c} ± 2.7	6.6^{ef} ± .2	2.8^{e} ± .9	5.3^{ghij} ± .2	9.4^{de} ± .4
March 1997	7.6^{c} ± 1.7	6.5^{ef} ± .3	6.6^{cde} ± 1.0	5.6^{fghi} ± .1	8.4^{ef} ± .5
July 1997	10.2^{c} ± 2.3	16.5^{b} ± 1.0	10.9^{bcd} ± 3.7	10.5^{b} ± .6	18.4^{b} ± .9
November 1997	10.9^{bc} ± 2.9	7.6^{de} ± .5	12.5^{ab} ± 3.2	8.4^{c} ± .4	9.7^{cd} ± .4
March 1998	10.3^{c} ± 2.9	3.3^{g} ± .5	12.3^{bc} ± 3.2	3.8^{k} ± .2	5.2^{h} ± .4
July 1998	9.0^{c} ± 3.2	6.3^{ef} ± .6	11.1^{bcd} ± 2.9	6.1^{def} ± .3	7.8^{fg} ± .4
November 1998	15.4^{b} ± 5.8	5.5^{fg} ± .5	16.9^{b} ± 8.6	4.5^{jk} ± .2	7.2^{g} ± .5
March 1999	16.9^{b} ± 8.6	8.2^{cd} ± .7	-	6.9^{d} ± .2	10.6^{c} ± .4
July 1999	6.8^{c} ± 1.8	5.9^{fg} ± .6	-	5.3^{fghij} ± .2	7.5^{g} ± .3
November 1999	17.9^{b} ± 11.2	7.3^{def} ± .8	-	6.9^{de} ± .3	9.4^{de} ± .5
March 2000	13.1^{bc} ± 3.2	10.4^{c} ± 1.1	4.6^{cde} ± .6	5.9^{efgh} ±.4	7.5^{g} ± .4
July 2000	3.3^{c} ± 0.0	6.1^{fg} ± 1.1	-	6.0^{defg} ± .3	10.4^{cd} ± 1.0

[a] Cystic = Encapsulated lesion containing fluid; Nodular = Lesion with nodules, the central foci of necrosis, surrounded by granulomatous inflammation; Mineralized = Lesion containing mineralized remnants of muscle cells; Clear = Older lesion that contains primarily clear connective tissue; Woody Callus = Older lesion characterized by infiltration with organized connective tissue and fat.
[b,c,d,e,f,g,h,I,j,k] Means, within a column, lacking a common superscript letter differ ($P < 0.05$).