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Preliminary observations on fresh and healed scars in deer skins

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ABSTRACT

To improve knowledge of where frequent damage to deer skins was occurring, and how to quantify it, studies were carried out at deer slaughter plants (DSPs) in the South Island, New Zealand. Skins from supplying farms were identified using a pattern punched into the fresh skin. In Part A, scarring was assessed following de-hairing and pickling, in skins from three suppliers at each of five slaughter plants. On average there were 4 (range 0-17) fresh and 7 (range 0-85) healed scars per skin. Effects of supplier and DSP on the number of fresh and healed scars were observed ($P<0.001$), with some achieving very low levels of damage, and some showing frequent, consistent forms of damage. In Part B, skins were assessed at wet-blue and finished leather stages, from deer killed in nine slaughter groups over three days at one DSP. In wet-blue skins, slaughter groups differed in the number ($P<0.001$) and severity ($P<0.01$) of healed scars, while in finished leather, slaughter groups differed significantly in damage score ($P<0.05$). Together the studies showed effects of supplier and DSP on the amount, severity and type of deer skin damage.

Keywords: deer skin; farming; scars; skin damage; farm source; processor.

INTRODUCTION

Hides from farmed deer in New Zealand are almost always damaged from recent or old injuries. Typically, more than 90% of hides have recent or old scars (Neil Dickson, New Zealand Light Leathers, pers. comm.), despite optimism in the 1990s that the uptake of industry quality assurance systems would allow more deer to reach slaughter undamaged (Fennessy *et al*., 1991). In a study of 64 tanned hides from one farm, 84% were recorded as scratched and 39% were scarred (Gore *et al*., 2002). Concern about quality was raised recently by a deer skin exporter, who called for increased awareness of the potential for damage to occur during yarding and transport (Deer Industry News, 2007). Unfortunately, it is difficult to screen for damage before the skins are fully processed into leather because bruising (and possibly other factors) can initially hide these flaws (Gore *et al*., 2002).

Hide damage has major commercial implications because it affects quality and price. It remains a goal of the deer industry to reap the commercial potential of hides (Deer Industry New Zealand, 2004). Damage is also of concern because it indicates that deer welfare has been compromised through injury.

Known sources of damage on deer farms include ticks (which leave characteristic marks) and injuries. Fighting and bullying occur in the paddock (Moore *et al*., 1985) and no doubt these activities contribute to scars on the skin. Deer are prone to injuring themselves and each other during handling, when they readily pile up, striking and raking each other with their hooves. Closely confined deer become aggressive and often kick, butt with the head and bite hair out of each other (Pollard & Littlejohn, 1996; 1998; 1999).

Prior to slaughter deer are subjected to intensive handling and prolonged confinement, so skin damage seems inevitable. Impending Codes of Welfare for deer require a minimum of four and no more than 12 hours yarding prior to transport. Typically deer are then loaded and then transported for several hours, unloaded and then left in lairage for the night before washing and slaughter the next morning. Throughout overnight lairage, aggression escalates (Pollard *et al*., 1999), and further agitation occurs during pre-slaughter handling, making the deer especially prone to injuring themselves and each other (Pollard *et al*., 1999).

The aims of the two studies presented here were to improve knowledge of factors contributing to old and recent scarring, and to identify how best to proceed in future studies aimed at reducing these problems.

MATERIALS AND METHODS

Part A

In March 2003, at five deer slaughter plants (DSPs), on one day, up to 20 skins were collected from deer from each of three suppliers at random. The deer were held in lairage pens overnight at the DSP, but the time of yarding and handling on the farm of origin were unknown. Each supplier's skins were identified with a unique hole punch pattern. The skins were cooled in water and transported to a skin processor where they were treated as one batch for de-hairing and pickling.

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The pickled skins were spread, grain side up, on a table and the number of fresh and healed scars were counted. The severity of the worst fresh and worst healed scar on the hide were recorded on a scale from zero (no scar), 1 (tiny scar) to 5 (long or wide).

The data were analysed using regression analysis fitting DSP and supplier for the number of fresh and healed scars. A logit link function was used to analyse the data for the severity score of both types of scarring. Linear discriminant analysis was used to analyse the scored data to determine how well the mean values for DSPs could be separated. Fresh and healed scars were the variables used to discriminate between the DSPs.

Part B

In June 2004, a total of 415 deer skins from one slaughter plant, from animals killed over three successive days, were examined. Each day, three slaughter groups from three suppliers were used. All animals had been held in lairage pens overnight, but the time of yarding and handling on each farm of origin were unknown. A very small number of stags were slaughtered on these three days (n = 21) and all but three came from one supplier on one day, so the data for stags was excluded from the analysis.

The skins were treated as in Part A, but the assessment methods were not identical. The number of scars on the pickled skins was scored rather than counted, because counting the scars in Part A was very time consuming. A score of 1 denoted zero to a few scars and a score of five represented many scars. The severity of scars was scored as in Part A.

The finished leather was graded by a professional grader, and was also scored for the number of scars (by a member of the research team). The professional grader placed the skins into one of three commercial categories: "table run" skins were of good quality with relatively few faults in the main panels either side of the midline (the midline is the backbone in the live animal); "table run light" were thin skins with few faults as per the table run grade; and "thirds" were skins with greater amounts of damage than the other two grades. These grades were given scores of 1, 2 and 3 respectively for the purposes of analysis.

A fresh scratch made in the skin shortly before slaughter is clearly identifiable in the finished leather as shown in Figure 1, and an easily identified healed scar is shown in Figure 2, but this was not true of all scars. Some scars are difficult to reproduce photographically, yet they are easily seen when the skin can be handled and held at different angles to the incident light. Fresh scars in the pickled skin or wet blue state appear similar to Figure 1 but do not reproduce well in black and white due to a lack of contrast, and healed scars are more difficult to capture photographically (Gore *et al*., 2002). Tanning methods and choice of finished colour (black in this case) are two ways of hiding flaws of many kinds, and the trial was carried out in a commercial tannery with a desire to maintain profitability. In the finished leather it was not possible to clearly distinguish between all fresh and healed scars, so a score for total scarring was used. The finished leathers were scored 1; if there was moderate damage on the midline only, score 2; where damage was on the midline and one side, score 3; where damage was on the midline and both side panels and score 4; where there was some damage to most of the skin. Since the tanning and dyeing processes cover up scarring, much of the variation had disappeared at this point and a four point scale was settled upon.

The damage variables were analysed using ANOVA, fitting the terms day and slaughter group. The relationship between the damage score and leather grade data was analysed using linear regression.

RESULTS

Part A

The mean number of fresh scars on a skin was 4.1 (SE 0.19, range 0 to 17), and differed significantly between suppliers ($P<0.001$). One supplier produced as few as 0.7 fresh scars per skin, while another two suppliers had more than 10 times as many. Most of the skins from one supplier had a long fresh deep cut along the right shoulder, which looked as though it had been inflicted by a sharp protrusion. The number of fresh scars also differed significantly between plants ($P<0.001$), with one plant showing particularly high levels of this type of damage.

Healed scars reached much greater numbers than fresh scars, with a mean of 6.5 (SE 0.37) and range of 0 to 85 per skin. As with fresh scars, there were significant differences between suppliers and between DSPs in the number of healed scars ($P<0.001$). There was a very high incidence of healed scars on the skins from one supplier (mean = 19 scars per skin) which appeared to have been caused by something like barbed wire or gorse. A different supplier's deer showed a pronounced large healed scar over the rump on every skin. Damage from tick bites was evident on over half of the skins from another supplier.

The severity of fresh scars was found to be significantly different between DSPs ($P<0.05$) but not suppliers. At one DSP, there were two

Figure 1: Some small fresh scars (longest 15 mm) as they appear in the finished leather, having been made in the skin shortly before slaughter.

Figure 2: A healed scar in the finished leather (30 mm long), having been made in the skin a considerable time before slaughter.

healed scars (Plants 2 and 5). No significant effect of DSP or supplier was found on the severity of healed scars. No significant correlation was found between the number of fresh and healed scars.

Part B

In wet-blue skins, no significant differences between days or slaughter groups in the number or severity of fresh scars were found (Table 1). The mean score for fresh scars per skin was 2.0 (SE ± 0.05), and the mean severity score was 1.6 (SE ± 0.05). For healed scars, again no effect of day of slaughter was found, but significant differences were found between slaughter groups in the number ($P<0.001$) and severity ($P<0.01$) of this type of damage (Table 1). In finished leather,

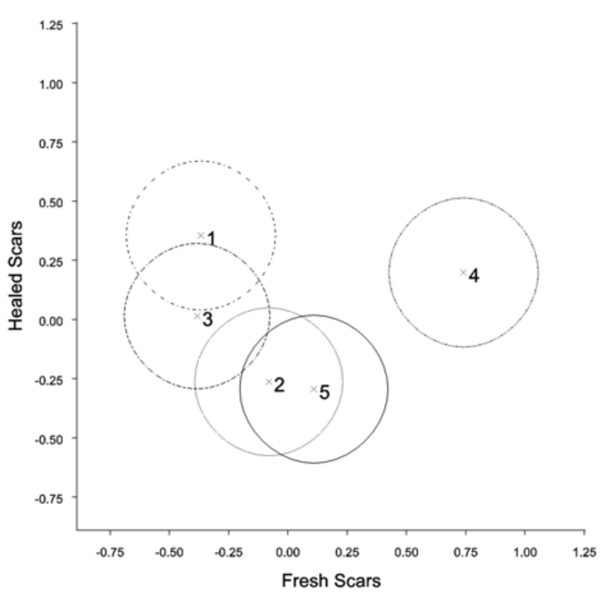
Table 1: Mean number and severity of fresh and healed scars for each slaughter group, assessed during the wet-blue processing stage (significance: Ns = not significant; ** = P<0.01; *** = P<0.001)[1].

Day	Transporter	Supplier	Slaughter group	No. skins	Fresh scars		Healed scars	
					Number	Severity	Number	Severity
1	A	A	1	10	2.0	1.6	2.7	2.3
1	A	B	2	13	1.8	1.8	2.5	1.9
1	nil	C	3	26	1.8	1.4	1.9	1.6
2	nil	D	4	34	1.8	1.4	2.2	1.6
2	B	E	5	143	2.2	1.6	2.5	2.1
2	nil	C	6	13	2.0	2.1	2.1	2.2
3	C	F	7	27	1.9	1.8	2.3	1.7
3	D	G	8	35	1.9	1.7	2.9	2.4
3	nil	C	9	114	2.1	1.7	1.8	1.7
Pooled Standard Deviation within groups					0.94	0.93	0.96	1.08
Significance					Ns	Ns	***	**

[1]To compare between any two slaughter groups calculate LSD 5% using the following formula: multiply the pooled standard deviation by the square root of (1/n1 + 1/n2).

suppliers of skins with very severe fresh scars (mean score greater than three). Figure 3 shows that skins from some plants carried less than the average severity of fresh scars (Plants 1, 2 and 3), while the skins from some carried less severe slaughter groups differed significantly in leather damage score (P< 0.05) but not leather grade. The leather damage score and grade were positively correlated (P<0.01).

Figure 3: Graphical representation of the outcome of linear discriminant analysis showing fresh *vs.* healed scars, and confidence ellipses for five different DSPs. The units on the axes represent the deviation from the mean, for example DSP 3 had below average score for fresh scars and an average score healed scars while DSP 4 had well above average score for fresh but only slightly greater score for healed scars.



DISCUSSION

In Part A of the study, suppliers varied greatly in the amount of fresh and healed damage on their deer skins. Farmers managing to keep skin damage to a minimum may have superior management or handling techniques. Perhaps some have genetically calm deer, although this possibility was not supported by the lack of correlation between fresh and healed scars. Effects of the transporter may have contributed to the variation in the fresh damage observed, but this was not quantified.

In Part B, differences between groups within days were not seen in fresh scars but significant differences were observed between groups in the number and severity of healed scars. In light of the information obtained in these two experiments we suggest that fresh scars might be inherent to the slaughter facility. The fact that very few stags were slaughtered on the three days of observations may also have some influence on this outcome, since gender can affect skin damage (Passman & Halligan, 1989).

In Part A, the significant effects of DSP on the number of fresh scars indicated that DSPs have practices or facilities which create better or worse outcomes for the deer and their skins. However these conclusions can only be tentative because of possible confounding effects of transporter (*e.g.* one transporter may have delivered deer from all three suppliers), or chance effects (such as all deer supplied having a low level of damage).

The finding that DSPs differed significantly in the number of healed scars could not be attributed to the DSP itself because wounds sustained there would not have had time to heal. Therefore chance or regional effects may have created this outcome. The linear discriminant analysis portrayed in Figure 3 makes DSP 4 look relatively bad with more than average of both types of scarring, but it must be remembered that due to the constraints of the experiment the three suppliers that sent their deer to this DSP could be the source of this damage as could the transporters who carried them.

It must be noted that the subjective grades for the finished leather are an accumulated visual appraisal of many factors such as size, shape, thickness and scarring. Yet within scarring alone there could be a number of causes such as fighting or wounds from structures such as fences, yards or transport crates. The leather grade is very relevant to its final use, which in the present study was garment or accessory manufacture. We should not lose sight of the end use, but for research purposes we were forced to focus on one component, that of scarring of any kind, in isolation from other forms of damage like flaying cuts and torn skins. It is encouraging that there was a correlation between the score for scarring of leathers by the researcher and the grading given by the professional assessor.

Given the limited design of the experiment we must be cautious, but would like to suggest that the environment on-farm and in the short period before slaughter, has a large effect on scarring. Environmental effects should be easy to identify and minimise, and perhaps more important than damage to the skin is the potential bruising of the venison below. Any correlation between skin damage and carcass bruising would be of great interest to the deer industry. The best experimental design would be to process a group of deer from each of a number of suppliers, using each of a number of transport operators delivering to each of a number of slaughter plants. We suggest that scoring the damage to the pickled or wet blue skins is faster where many skins are available, but counting the number of scars provides more quantitative information when group sizes are small. Scoring of leathers was useful in terms of end product use of the leather but given that the colour and finishing concealed much of the variation in scarring, we suggest that research on the partially processed pickled or wet blue skins is more appropriate.

Linear discriminant analysis is used in statistics to find the linear combination of features which best separate two or more classes of object or event. Linear discriminant analysis is closely related to analysis of variance and regression analysis, which also attempt to express one dependent variable as a linear combination of other measurements. However, the dependent variable in analysis of variance and regression is a numerical quantity, while for linear discriminant analysis it is a categorical variable (*i.e.* score). The linear discriminant analysis was an elegant method for use with scored data in Part A, but using analysis of variance in Part B was considered valid given the robust nature of the test particularly given the more widespread understanding of the outcome.

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