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The Effect of Eradication of Lice on the Occurrence of the Grain Defect Light Flecks and Spots on Cattle Hides

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Nafstad O, Grønstøl H: The effect of eradication of lice on the occurrence of the grain defect light flecks and spots on cattle hides. Acta vet. scand. 2001, 42, 99-106. – The influence of an eradication programme for lice on the prevalence of light flecks and spots on cattle hides was studied in 33 dairy cattle herds during a period of two and a half years. Lice were eradicated from the main group of herds after 9 to 12 months and the quality of the hides before and after treatment was compared. Hides from slaughtered animals were collected during the study period, tanned and examined with special emphasis on the occurrence of the grain damage light flecks and spots. The prevalence of hides without light flecks and spots increased from 24.2% before treatment to 61.6% after treatment. The prevalence of hides free from the damage increased significantly in all examined anatomical regions. The improvement in hide quality was most marked in the shoulders and neck region which corresponded to the major predilection site of cattle lice. The prevalence of hides with light flecks and spots started to decrease in the first period (2-40 days) after eradication. The changes after treatment suggested that most healing process took place over a period of about 4 months. The eradication programme eliminated the seasonal variation in the prevalence of light flecks and spots which was present before treatment.

cattle hide; leather; damage; light flecks and spots; eradication.

Introduction

Light flecks and spots were described and precisely defined for the first time by *Webster & Bugby* (1990). These investigators defined light flecks and spots as small areas of grain loss up to 3 mm in diameter that are seen on dyed crust bovine leather and associated the damage with presence of lice. Both biting lice *(Damalinia (Bovicola) bovis* (Linnaeus 1758)) and sucking lice (*Linognathus vituli* (Linnaeus 1758)) caused light flecks and spots, but biting lice seemed to be the most important. Treatment with insecticides decreased the occurrence of damage significantly (*Bugby et al.* 1990, *Webster & Bugby* 1990). Similar damage has also been described by other authors and associated with various ectoparasite species (*Everett et al.* 1977, *Rotz et al.* 1983, *George et al.* 1986).

The occurrence of light flecks and spots on Norwegian cattle hides was estimated for the first time in 1991 by tanners from all Nordic countries. Based on a commercial evaluation and classification, the tanners found lice related damage on 50%-55% of the Norwegian hides (*Dørum,* personal communication). The damage was present on 75.8% of the hides before treatment in the present investigation (*Nafstad & Grønstøl* a). This evaluation was based on a more detailed examination of the hides and is not directly comparable with the tanners' report.

Eradication as a control strategy of ectoparasites in domestic animals is described and assessed in general by *Hiepe* (1986). In the present study, a clinical evaluation of an eradication programme for the control of lice in cattle was undertaken together with the investigation of the hides. The results of the clinical evaluations indicated that eradication can be an appropriate control strategy for lice in cattle (*Nafstad & Grønstøl* 2001b). The aim of this paper was to compare the leather quality and the occurrence of light flecks and spots on cattle hides before and after the eradication of lice.

Materials and methods

Design

A prospective cohort study was performed in 33 dairy herds during a period of two and a half years with animals leaving or entering the herds at any time. Hides from all animals slaughtered in the 33 herds from 1. January 1994 to 30. June 1996 were collected and examined after tanning for ectoparasite related damage. Twenty-eight of the herds were treated to eradicate lice in the second third of 1994. Five herds took part in a pilot study and were treated to eradicate lice in December 1993. Hides from these 5 herds were only included in the "after eradication" group. The treatment scheme, clinical evaluation and results of the lice eradication programme are presented elsewhere (*Nafstad & Grønstøl* 2001b).

Herds, animals and hides

The herds were selected by the District Veterinary Officers in Akershus and Østfold. Selection criteria and ectoparasite status are described previously (*Nafstad & Grønstøl* 2001b). The herd size varied from 8 to 50 dairy cows. In total, 1032 hides were collected during the whole investigation period, 368 from the period before eradication and 664 from the period

Table 1A. Effect of eradication of lice on the occurrence of light flecks and spots on cattle hides.

	Number of hides	Average of hide sum scores	Max. score			
			0	1	2	3
Before eradication	368	3.52	24.2%	37.2%	31.3%	7.3%
After eradication	664	1.46	61.6%	21.1%	14.6%	2.7%

$p < 0.001$

Score 0: No damage
Score 1: Slight damage, with 1-2 light fleck or spot pr. 100 cm^2.
Score 2: Some damage, with 3-5 light fleck or spots pr. 100 cm^2.
Score 3: Severe damage, with more than 5 light fleck or spots pr. 100 cm^2.

Table 1B. Frequency of damage on hides from animals born after eradication.

	Number of hides	Average of hide sum scores	Max. score			
			0	1	2	3
Hides from the subgroup of animals born after eradication	49	1.61	65.3%	12.2%	16.3%	6.1%

Table 2. Effect of eradication of lice on the frequency of light flecks and spots in different regions of the hide (n=1032).

Region	Time	Max. score				p-value
		0	1	2	3	
Neck and Shoulders	Before eradication	32.1%	40.0%	23.9%	4.1%	
	After eradication	70.0%	21.5%	7.5%	0.9%	<0.0001
Forelimbs and dewlap	Before eradication	60.9%	24.5%	11.4%	3.3%	
	After eradication	77.6%	11.5%	9.2%	1.8%	<0.0001
Back	Before eradication	67.9%	15.2%	13.0%	3.8%	
	After eradication	90.4 %	7.1%	2.1 %	0.5%	<0.0001
Rump, hindlimbs, sides	Before eradication	84.5%	13.3%	2.2%	0.0%	
And belly	After eradication	90.4%	7.1%	2.1%	0.5%	<0.007

Score 0 - No damage
Score 1 - Slight damage, with 1-2 light fleck or spot pr. 100 cm^2.
Score 2 - Some damage, with 3-5 light fleck or spots pr. 100 cm^2.
Score 3 - Severe damage, with more than 5 light fleck or spots pr. 100 cm^2.

after eradication. The mean number of hides from each herd was 13.1 before treatment with a variation from 2 to 21. The mean number from each herd after treatment was 20.2 with a variation from 7 to 51.

Examination of the hides

The tanning procedure and examination of the hides are described previously (*Nafstad & Grønstøl* 2001a). Light flecks and spots were defined as areas of grain loss up to 3 mm in diameter seen on dyed crust leather (*Bugby et al.* 1990, *Webster & Bugby* 1990). The evaluation was based on the number of identifiable flecks and spots and was performed according to the following scale:

Score 0: No damage.
Score 1: Slight damage, with 1-2 light flecks or spots per 100 cm^2.
Score 2: Some damage, with 3-5 light flecks or spots per 100 cm^2.
Score 3: Severe damage, with more than 5 light flecks or spots per 100 cm^2.

Statistical methods

Eight registrations from each hide were used to derive two parameters. The maximum score was defined as the highest single registration on each hide and the sum score was defined as the sum of the 8 registrations on each hide. If only one half of a hide was available, a duplicate result from the available half of the hide was used in the statistical analyses.

The Statistical Analysis System (*SAS Institute Inc.* 1996) was used for data processing and statistical analysis. Spearman's rank correlation was used for testing changes with time after eradication. Otherwise, statistical hypothesis testing was carried out by use of t-test. The statistical testing was based on the frequency of hides without damage (maximum score 0) or the average of the sum scores for the groups.

Results

Effect of eradication

The frequency of cattle hides without light flecks and spots increased from 24.2% before

Table 3. Change in frequency of damaged hides after eradication.

Period no. (Days after eradication)	Number of hides	Average of hide sum scores	Max. score				Percentage of hides from reinfected herds
			0	1	2	3	
I (2-136)	170	1.79	54.1%	25.9%	17.7%	2.4%	2.4%
II (137-326)	162	1.29	62.4%	25.3%	10.5%	1.9%	17.9%
III (326-477)	166	1.13	68.1%	19.3%	10.2%	2.4%	32.5%
IV (>477)	166	1,63	62.1%	13.9%	19.9%	4.2%	51.8%

Change in periods I-III $p < 0.001$ (Spearman correlation test)

Score 0 - No damage
Score 1 - Slight damage, with 1-2 light fleck or spot pr. 100 cm^2.
Score 2 - Some damage, with 3-5 light fleck or spots pr. 100 cm^2.
Score 3 - Severe damage, with more than 5 light fleck or spots pr. 100 cm^2.

the eradication of lice to 61.6% after eradication. The average sum score of the hides in the group decreased from 3.52 before eradication to 1.46 after eradication. The general effects of the eradication of lice are presented in Table 1A. The results from the subgroup of hides from animals born after the eradication of lice are shown in Table 1B. There were no significant differences between this subgroup and the group of hides from all animals slaughtered af-

Table 3B. Change in frequency of damaged hides in first 136 days after eradication.

Period no. (Days after eradication)	Number of hides	Average of hide sum scores	Max. score			
			0	1	2	3
I (2-40)	43	2.58	39.5%	37.2%	20.9%	2.3%
II (41-87)	43	2.26	62.4%	25.3%	10.5%	1.9%
III (88-110)	46	1.13	68.1%	19.3%	10.2%	2.4%
IV (111-136)	38	1,19	62.1%	13.9%	19.9%	4.2%

Period 1 and 2 significantly different from 3 and 4. $p = 0.013$

Table 4. Seasonal variations in the frequency of light flecks and spots after the eradication of lice.

Months	Number of hides	Max. score			
		0	1	2	3
Jan. Feb.	163	69.9%	16.0%	11.7%	2.4%
Mar. Apr.	141	57.5%	26.2%	13.5%	2.8%
May. Jun.	101	57.4%	22.8%	18.8%	1.0%
Jul. Aug.	61	68.9%	13.1%	16.4%	1.6%
Sep. Oct.	97	59.8%	21.7%	14.4%	4.1%
Nov. Dec.	101	55.5%	24.8%	15.8%	4.0%

Score 0 - No damage
Score 1 - Slight damage, with 1-2 light fleck or spot pr. 100 cm^2.
Score 2 - Some damage, with 3-5 light fleck or spots pr. 100 cm^2.
Score 3 - Severe damage, with more than 5 light fleck or spots pr. 100 cm^2.

ter eradication. An increasing proportion of the hides came from reinfected herds as the observation period progressed, and 53% of the hides from animals born after eradication came from reinfected herds. There were no significant differences between hides from reinfected herds and hides from herds that remained free of lice. The eradication both decreased the proportion of hides with damages and the extent of damage on affected hides. The average sum score of affected hides decreased from 4.64 before eradication to 3.80 after eradication ($p< 0.01$). The quality of the hides from the herds in the pilot study did not differ from the quality of the hides in the main group after treatment. Sixty-one per cent of the 199 hides that were collected from the herds in the pilot group were free of light flecks and spots.

Effect of eradication in various anatomical regions

Following the eradication of lice, there were significant reductions in frequency of light flecks and spots in all anatomical regions examined on the cattle hides (Table 2). Accordingly, the frequency of hides without damage increased in all anatomical regions. The neck and shoulders were the region with the highest incidence of damage before treatment. This region also showed the largest change in the prevalence of light flecks and spots after treatment.

Change with time after eradication

The change in the frequencies of damage during the whole period after eradication is shown in Table 3. The frequencies of hides without damage increased significantly during the periods I-III. The percentage of hides from reinfected herds increased noticeably with time after eradication up to 53.8% in period IV. Hides from period I (2-136 days after eradication) are classified in more details according to time after eradication in Table 3B. The frequency of hides without damage increased significantly during periods 1-3. The difference between period 3 and 4 was not statistically significant.

Seasonal effects

The seasonal variation in hide damage after the eradication of lice is presented in Table 4. There was no significantly seasonal variation in the frequency of light flecks and spots after treatment.

Discussion

Systematic treatment for the eradication of lice decreased the frequency of hides with light flecks and spots from 75.8% to 38.4%. The extent of damage on affected hides also decreased significantly. This investigation confirms the importance of lice for the development of light flecks and spots on cattle hides and supports the observations of *Bugby et al.* (1990) and *Webster & Bugby* (1990), who were the first to suggest lice as the main cause of light flecks and spots on cattle leather.

The frequencies of hides with light flecks and spots decreased in all anatomical regions after the eradication of lice. The distribution of damage before treatment corresponded to the distribution of lice on the animals (*Chalmers & Charleston* 1980, *DeVaney et al.* 1988). The difference in the presence of damage in regions of the hide before and after treatment was most marked in the neck and shoulder region, which is the major predilection site of cattle lice.

For the whole period after eradication, 38% of the hides were still affected by light flecks and spots. The period with highest frequency of hides without damage was 326 to 477 days after eradication. The frequency of hides without damage subsequently decreased, probably due to the proportion of hides from reinfected herds. Given the design of the study, it was not possible to estimate an exact time of reinfection. However, the lice population in the reinfected herds was much lower after reinfection than before eradication. Because of these findings, it was decided to include the hides from all herds even after the reinfection. The frequency of hides with light flecks and spots from animals born after eradication was similar to the frequency from animals born before eradication, about 35%. These results indicate that light flecks and spots may have causes other than lice and suggest that while the hide damage is closely associated with lice, it is not specific for lice. According to the results of the present study, 40%-45% of the light flecks and spots seemed to have causes other than lice under Norwegian conditions. *George et al.* (1986) suggested that *Psoroptes ovis* (Herning 1838) infestations in cattle may cause light flecks and spots, but this ectoparasite does not occur in Norway. *Everett et al.* (1977) found that damage similar to light flecks and spots was caused by various tick species, but could identify no evidence of hide damage caused by short nosed sucking lice (*Haematopinus eurysternus* Denny 1842), flies or mosquitoes. Under Norwegian conditions, *Ixodes ricinus* (Linneaus 1758), is the only present tick. However, this tick was not included in the present investigation because only two herds were localised in areas where this tick usually occurs. The distribution of the damage on hides also differed from the expected distribution of damage caused by ticks. Recent research by British Leather Confederation (BLC) has suggested that the stable fly (*Stomoxys calcitrans* Linnaeus 1758) may be a cause of light flecks and spots (*Bugby* personal communication). This fly may also be a cause of hide damage under Norwegian conditions, but so far this has not been confirmed. It should be noted that the treatment in the present study may have a temporary effect on the fly population in the herds. However, stable fly may be a cause of the persistence of light flecks and spots on hides after the eradication of lice.

The frequency of hides without light flecks and spots increased significantly from the first period after eradication and the highest frequency was present in period III, 326-477 days after treatment. This result is consistent with the suggestion that the healing period for injuries induced by lice was more than 12 months (*Christensson et al.* 1994). However, findings in the present study also indicate that most of the healing occurs much faster. The frequency of

hides without damage increased to more than 60% during the first three to four months after treatment. This observation was possibly confounded by the increasing proportion of hides from reinfected herds over the period of the present study. The investigation by *Bugby et al.* (1990) showed very slight damage on the leather nine weeks after treatment. These authors suggested however, that hides from animals which had been infested with lice could never be used for top quality aniline leather. More research is needed to determine more precisely the duration of the healing period following injuries induced by lice.

Before treatment, the frequency of hides with light flecks and spots varied significantly during the year. The variations were consistent with lice as a main cause of the damage and the frequency of hide damage varied according to the changes in the lice population during the year (*Nafstad & Grønstøl* 2001a). The demonstration in the present study that this seasonal variation is eliminated following the eradication of lice, emphasises the importance of lice for the development of light flecks and spots on cattle hides.

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Sammendrag

Effekten av sanering for lus på forekomsten av narvfeilen lyse flekker og prikker på storfehuder.

Hudene fra alle dyr slaktet i 33 mjølkeproduksjonsbesetninger gjennom to og et halv år ble samlet inn og undersøkt for overflateskaden lyse flekker og prikker etter garving. En gruppe på 28 besetninger ble sanert for lus 8 til 12 måneder ut i forsøksperioden, mens fem av besetningene var sanert for lus umiddelbart før forsøksperioden startet. Totalt ble det samlet inn 368 huder fra perioden før sanering og 664 huder fra perioden etter sanering. Hudene ble kromgarvet og vegetabilsk ettergarvet til annilinlær og undersøkt før siste overflatebehandling av læret. Skaden lyse flekker og prikker forekom på 75,8% av alle huder før sanering og på 38,4% av alle huder etter sanering. Nedgangen i forekomsten av skader var signifikant for alle anatomiske regioner av huden, men var mest markert for regionen nakke og skuldre der andelen huder uten skade steg fra 32,1% før sanering til 70,0% etter sanering. Nakke og skuldre utgjør det

viktigste predileksjonsstedet for pelslus *(Damalinia bovis)* og er et sentralt predileksjonssted også for blodlus *(Linognathus vituli)*. Effekten av sanering for lus bekreftet dermed disse luseartene sin sentrale betydning for utviklingen av denne typen kvalitetsfeil på lær. Nedgangen i forekomsten av lyse flekker og prikker startet umiddelbart etter sanering, den vesentligste kvalitetsforbedringen skjedde i løpet av de første fire månedene etter sanering. En stabil forekomst av lyse flekker og prikker på 30-40% av hudene også etter sanering kan indikere en lang avhelingstid, eventuelt at skader lus påfører huden slik de framstår etter garving er delvis livsvarige. Forekomsten av skader etter sanering kan også indikere at skaden lyse flekker og prikker ikke er spesifikk forårsaket av lus, men også kan skyldes andre ektoparasitter. Under norske forhold er trolig stallflue *(Stomoxys calcitrans)* sentral i tillegg til de to luseartene. Sanering for lus opphevet den sesongmessige variasjonen i forekomsten av lyse flekker og prikker.

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