

VARIATIONS AND CARCASS BRUISING IN BEEF CARCASSES FROM TWO SLAUGHTERHOUSES

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SUMMARY

Examination of ultimate pH and bruising in 2,360 beef carcasses has shown, that 3% of the carcasses had pH values higher than 6.2. The incidence was 5% in young bull carcasses and 2% in cow carcasses. The bruises on the rump were mostly found on the tuber ischii and the 13th rib. 13% of the carcasses had heavy bruises on the rump, 8% on the loin and 6% on the shoulder. The cows were found to be most susceptible to bruising, 12% of the cow carcasses had deep bruises on the rump whereas only 2% of the young bull carcasses were found to be bruised with deep bruises on the rump. Horned cattle developed high pH with significantly higher frequency ($p < 0.001$) than dehorned cattle. The investigation showed no correlation between bruises and animals with horns.

The lairage time at the slaughterhouse influenced the incidence of bruises, and this indicates that the cattle get bruised on lairage or when they are establishing hierarchy or mounting.

Transport method, supply route, horns, lairage conditions, category, EUROP conformation and carcass weight were found to account for about 13% of the variation in pH, and approximately 25% of the variation in carcass bruising.

INTRODUCTION

The distance between the farmer and the slaughterhouse is relatively short in Denmark. The duration of the transport of cattle for slaughter will in most cases be less than 4–6 hours. On average 25% of the cattle is acquired through market, where full truck loads are collected and delivered to the slaughterhouse. About 75% of the animals are collected directly from the farms, and the trucks may have to visit several times in order to collect a full load. In this study 15–20 different trucks brought animals to one of the slaughterhouses and 88 trucks brought animals to the other.

Noisy conditions in the lairage area and road transportation factors may stress the animals (Eldridge, 1988a and b) and increase the bruising incidence. Stocking density in the truck has been shown to be important for the development of stress in cattle (Tarrant et al., 1988). In an examination of Friesian steers it was shown that animal welfare was impaired at high stocking densities, and that carcass bruising increased with stocking density (Tarrant, 1988). The stress response increased with location towards the tail of the truck, and loss of balance was observed when driving incidents, braking and cornering occurred. At low stocking density cattle tended to align themselves with the direction of travel.

The handling methods may influence the meat quality negatively but only a few previous investigations have been made in this area in Denmark (Buchter, 1981). The aim of this work was to evaluate the frequency of carcasses with high pH and to describe the extent and number of bruises in cows and young bull carcasses. The main factors that may have an adverse influence on meat quality were recorded to the extent it was possible.

MATERIALS AND METHODS

The investigation included four days of supply to two different slaughterhouses during 1991 and may therefore not be fully representative for all Danish beef abattoirs. For each animal the following information was registered:

- Transport method (loose or tied during transportation)
- Acquisition through market or direct delivery from farm
- Dehorned/horned
- Truck drivers identity
- Lairage time at the slaughterhouse
- Bruises on shoulder, loin and rump
- pH measured in the loin (18–20 hours post mortem)
- Category, EUROP conformation and carcass weight
- Ear tag registration number, CKR.
- Fresh hide damage was found in less than 1% of the hides (Outzen, 1991). Therefore, it is not included in this investigation.

After bleeding all the carcasses were electrically stimulated with low voltage, in order to accelerate rigor mortis. pH was measured 20 hours post mortem in the longissimus dorsi muscle and classified as normal ($\text{pH} \leq 5.9$), intermediate ($5.9 < \text{pH} \leq 6.2$) or high ($\text{pH} > 6.2$). In order to identify carcasses with slow glycolysis the pH measurements were repeated 4–6 hours later, and carcasses with high pH were noted.

Bruising was evaluated on the slaughterline immediately after dehiding and evisceration. Observations were made in three areas: Shoulder, loin and rump, and the severity described as: minor bruise, heavy bruise and deep bruise. Some of the heavy bruises and all bruises classified as deep bruises were trimmed on the slaughterline or at reinspection.

Data were examined by the following statistical methods:

- "Khi² test" for analysis of correlation between transport method, acquisition method, with horns or dehorned, lairage time, category EUROP conformation and carcass weight.
- Regression analysis to test the influence of the factors mentioned above on variation of pH and bruises.

RESULTS AND DISCUSSION

pH: Of the 2,360 heads of cattle 62% were young bulls, 33% were cows, 4% were heifers and 1% were steers. About 50% of the animals were slaughtered within two hours of arrival and 23% of all animals stayed overnight (Figure 1).

78% of the animals were dehorned, and the remainder were significantly ($p < 0.001$) more likely to develop high pH. 8% with high pH were found among horned young bulls, whereas only 3% of the dehorned young bulls developed high pH. 3% of the carcasses had $\text{pH} > 6.2$. The incidence was 5% in young bulls and 2% in cows (Table 1). No previous investigation in Denmark has shown that many carcasses with high pH, and the occurrence was higher than expected, although low. Carcasses of cows staying overnight did not develop high pH, in contrast to carcasses of young bulls, where 15% developed high pH when the animal had stayed overnight.

These findings correspond with results reported earlier by Buchter (1981) and Riette et al. (1989).

Transport method (loose or tied) showed no significant difference in the incidence of high pH, which was 3% in both groups. Incidence of carcasses with high pH was higher for carcasses with EUROP conformation O and P.

Table 1. pH in loin from different categories

Category	Number	Normal pH $5.9 \leq \text{pH}$		Intermediate pH $5.9 < \text{pH} \leq 6.2$		High pH > 6.2	
		Number	%	Number	%	Number	%
Young bulls	1399	1051	75	285	20	63	5
Steers	19	13	68	6	32	0	0
Heifers	93	77	83	15	16	1	1
Cows	774	629	81	133	17	12	2

Transport method, supply route, horns, lairage conditions, category, EUROP conformation and carcass weight were found in investigation to account only for about 13% of the variation in pH. Bruas et al. (1990) found in a similar study that duration of transport and lairage, carcass weight and quality, biological age and growth rate together accounted for about 18% of the variation in pH.

Bruises. An average of 1.3 kilo per carcass was trimmed off 154 carcasses. Bruising occurred mostly on the rump, where 5% of the carcasses had bruises were observed (Table 2). The cows were significantly ($p < 0.001$) more sensitive to bruising, 12% were found with deep bruises on the rump, whereas only 2% were found on carcasses of young bulls (Table 3). Lairage time may have influenced these findings.

Table 2. Distribution of bruises, all carcasses

	Severity of bruises			Deep, %
	None, %	Small, %	Heavy, %	
Shoulder	69	23	6	2
Loin	65	25	8	2
Rump	55	27	13	5

Significantly ($p < 0.001$) more bruises were observed when the animals were tied up during transportation in the trucks (Table 3). The difference was pronounced in the group of cows of which 63% arrived tied up. 14% of these cows had deep bruises compared to 2% of the young bulls.

arriving loose in the truck. No difference attributable to transport method was found among young bulls. About 2% had deep bruises relative of transport method.

Table 3. Incidence of bruises

Category	Shoulder		Loin		Rump	
	Heavy, %	Deep, %	Heavy, %	Deep, %	Heavy, %	Deep, %
Young bulls	3	1	3	1	6	2
Cows	0	5	5	5	10	0
Heifers	9	3	6	2	14	4
Transport method	12	5	15	5	25	12
Lairage time						
0-1 h.	9	3	11	3	16	7
1-2 hrs.	4	2	4	1	9	3
2-3 hrs.	5	3	6	2	11	4
3-4 hrs.	3	1	4	1	5	3
4-5 hrs.	4	1	8	2	12	4
5-6 hrs.	5	3	8	2	6	4
6-7 hrs.	6	2	6	3	14	7
7-8 hrs.	7	4	8	2	20	5
8-9 hrs.	11	2	13	3	22	8
More than 24 h.	15	3	15	8	22	15

Significantly ($p < 0.001$) more bruises were found on shoulder, loin and rump when animals were delivered directly from the farm. Finding was not expected but may be explained by a more frequent application of brakes and by more curves on the route.

The lairage time had a significant ($p < 0.001$) influence on bruising. Lairage for more than 6 hours increased deep bruising from 8 % in young bulls. Lairage systems and pens without "roof" may explain this. 13 % deep bruises on rump were found in cows considered two hours after arrival. Some of the bruises may originate from loading/unloading and truck transport, and some may be caused crowded pathways at the slaughterhouse.

The frequency of bruises increased with higher slaughterweight (Figures 2 and 3) as did the bruising on the rump of carcasses classified EUROP conformation class 0 and P.

Many other factors than those observed in this analysis may influence the occurrence of bruises. Transport method, acquisition through direct/direct delivery, horns, lairage time, category and EUROP conformation only explain 19%, 22% and 27% respectively of the variation in bruises on shoulder, loin and rump.

CONCLUSIONS

3% of young bulls, 2% of cows and 1% of heifers had high ultimate pH (18-20 hours post mortem). Young bulls with horns were more likely to develop high pH than dehorned young bulls. Cows are more likely to get bruises than young bulls; 12% of the cows had deep bruises on the rump against 2% of young bulls. Bruising increased significantly with longer lairage time. Higher slaughterweight resulted in more bruises on the carcasses. These results were found in two slaughterhouses at a given period. The results may not be representative for all Danish beef abattoirs at all times of the year.

Figure 1: Lairage time at slaughterhouse before slaughter

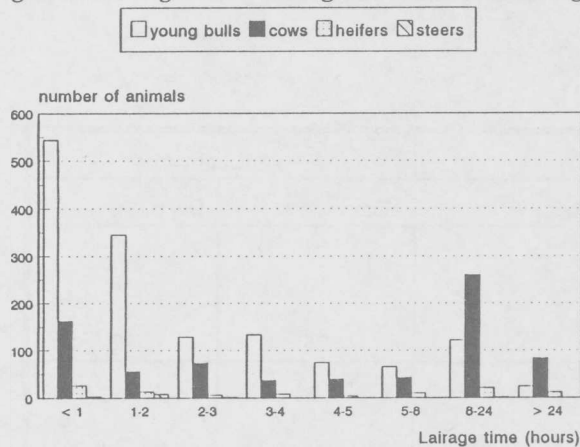


Figure 2: Bruises related to slaughterweight, Rump

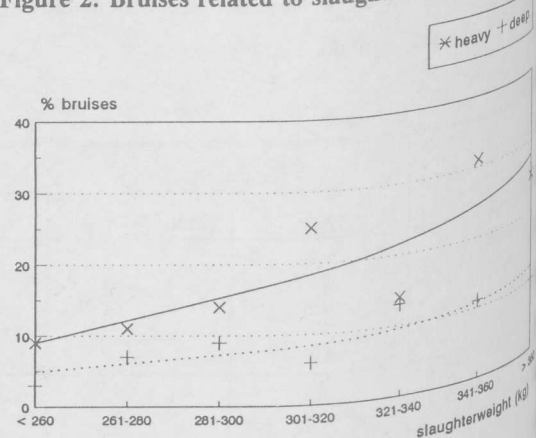
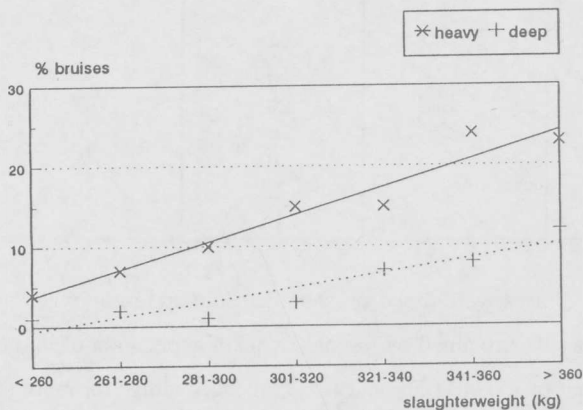


Figure 3: Bruises related to slaughterweight, Loin



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