DFD incidence in Swedish cattle

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INTRODUCTION

Dark cutting or DFD meat has always been a part of the butchers lore. In recent years it has become an increasing problem for the meat industry in Sweden as well as in other countries. The reason for this is not quite clear. Factors such as the increased awareness of the phenomenon and an increase in the use of vacuum packaging of beef are surely important, but it is not known if there is also a real increase in the incidence of DFD.

There is no general agreement on the limit of the ultimate pH indicative of dark cutting. In replies to a questionnaire Tarrant (1981) noticed that pH limits for DFD meat from 5.8 to 6.3 were suggested by different experts. Estimated incidences of dark cutting beef connected to the pH limits mentioned varied from nil and up to 26.3%. Taylor and Shaw (1977) divided meat into three groups according to pH and examined the spoilage tendency. High pH meat (pH > 6.2) spoiled more easily than meat with a pH of 5.9-6.1. Normal meat (pH < 5.8) did not develop this kind of early spoilage.

In the present paper the incidence of DFD in Sweden was studied. Muscles with a pH_{24} > 6.2 were classified as being DFD. Muscles with 5.9 < pH_{24} < 6.1 were classified as being intermediate. All other carcasses were considered to be of normal meat quality (pH < 5.8). The influence of some parameters of special interest for the development of DFD meat such as abattoir, animal category, season and lairage time, were evaluated.

MATERIAL AND METHODS

The study was performed in 1980 at four abattoirs in various parts of Sweden for two weeks at each during February, May, August and November. Low voltage electrical stimulation, which hastens the drop in pH, was put to use at the abattoirs in between recording periods.

The pH was measured in M. longissimus dorsi (LD) between the 10th and 11th rib 24 hours post mortem. A Knick Portamess 651 pH meter (Knick Elektronische Messgeräte, GFR) with an Ingold type 404 T meat electrode (W. Ingold AG, Switzerland) was used. A total of 2,686 carcasses were examined (601 cows, 33 old bulls, 282 heifers, 268 cowheifers, 110 steers, 1,288 young bulls and 104 calves). The following data were recorded for each animal: date of slaughter, distance of transport, lairage time at abattoir, sex, carcass weight, and electrical stimulation (NS = not electrically stimulated, ES = electrically stimulated). The effects - discontinuous main effects - of category, abattoir, season, and lairage time on the pH as well as regression of carcass weight and of transport distance were tested statistically using the Statistical Analyses System (Barr et al, 1979).

RESULTS AND DISCUSSION

DFD incidence

The frequency distribution of pH_{24} in LD, for the carcasses investigated, is shown in Table 1. In the ES carcasses DFD occurred in 3.4% of the LD muscles. The same pH limit for DFD applied to NS carcasses resulted in 13.2% DFD. Mean pH_{24} values for NS carcasses were consistently higher than for ES carcasses, probably mainly due to the fast pH drop caused by electrical stimulation. In electrically stimulated beef carcasses the ultimate pH is reached within 24 hours (Bendall et al, 1976), while in non-stimulated carcasses it is often not reached until 48 hours after slaughter (Bodwell et al, 1965).

The DFD incidence in the present investigation was high compared to some data reported in literature. Tarrant and

pH-value	LD NS n	%	Cum%*	LD ES n	%	Cum%
>6.4	43	6.1	6.1	39	2.0	2.0
6.3	19	2.7	8.8	11	0.5	2.5
6.2	31	4.4	13.2	17	0.9	3.4
6.1	55	7.8	21.0	23	1.1	4.5
6.0	79	11.2	32.2	54	2.8	7.3
5.9	107	15.1	47.3	88	4.4	11.7
5.8	91	12.9	60.2	177	9.0	20.7
<5.7	281	39.2	100.0	1571	79.3	100.0

Table 1. The distribution of pH_{24} in M. longissimus dorsi (LD) of not electrically stimulated (NS) and electrically stimulated (ES) beef carcasses.
*Cum% = Cumulative %

Sherington (1980) reported the incidence of DFD (pH_{48} > 6.0 in LD) to be 3.2% when examining NS carcasses of steers and heifers. Munns and Burrell (1966) estimated the incidence of dark cutting (pH_{48} > 6.0 in LD) in NS steers to be 8%. Puolanne and Aalto (1980a) reported the average incidence of DFD (pH_{24} > 6.0 in LD) to be as high as 22% when examining 13,286 NS carcasses.

Influence of abattoir

The incidence of DFD in the different abattoirs surveyed varied from 1.7% to 4.0% for ES carcasses and from 12.3% to 14.1% for NS carcasses (Table 2). Differences in the conditions of transport, the type of lairage and the handling of the animals could explain the differences between abattoirs. Puolanne and Aalto (1980b) pointed out the importance of the lairage conditions for the development of DFD.

pH-value	Abattoir 1				Abattoir 2				Abattoir 3				Abattoir 4			
	NS		ES		NS		ES		NS		ES		NS		ES	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
≥6.2	44	12.3	43	4.0	6	13.6	5	3.8	-		8	1.7	43	14.1	11	3.6
5.9-6.1	116	32.5	50	4.6	13	29.5	20	15.3	-		46	9.8	112	36.7	49	16.2
<5.8	197	55.2	984	91.4	25	56.8	106	80.9	-		416	88.5	150	49.2	242	80.1

Table 2. Distribution of pH_{24} in M. longissimus dorsi in the not electrically stimulated (NS) and in the electrically stimulated (ES) beef carcasses of four different abattoirs.

Differences between animal categories

The incidence of DFD meat in young bulls was almost twice as high as in any other category investigated (Figure 1). This is in accordance with oberservations by other authors (Puolanne and Aalto, 1980a; Tarrant, 1981; Augustini and Fischer, 1979). The total incidence of pH values > 5.9 was of the same order of magnitude for young bulls, cowheifers, cows and steers, thus indicating a potential risk for DFD also in the latter categories.

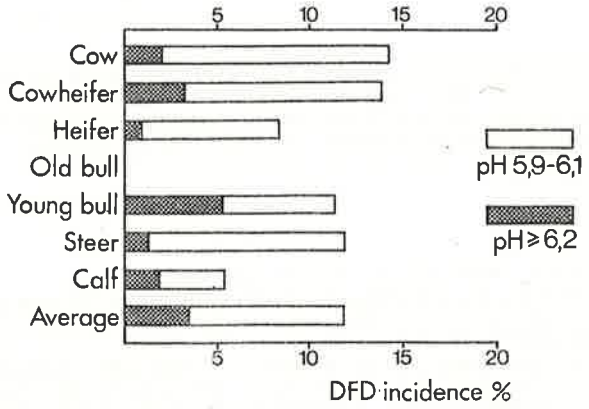

Figure 1. The incidence of DFD (closed bars) and of intermediate meat (open bars) in electrically stimulated carcasses of different animal categories.

Influence of season and lairage time

Seasonal variations in the incidence of DFD meat were evaluated in ES young bulls. Results showed that the highest incidence occurred in May (5.9%) compared to an incidence in August and November of 2.8% and 2.4%, respectively (Figure 2). The February period could not be included in the comparison since most of these carcasses were not electrically stimulated. The increase in the incidence of DFD in May could be linked to pronounced temperature differences between night and day at this time of the year or to inadequate feeding in the end of the long stabling period used in Sweden. The increase in May reported here is not in accordance with the findings by Munns & Burrel (1966) and by Tarrant & Sherington (1980) of an increase in the DFD incidence in the late autumn.

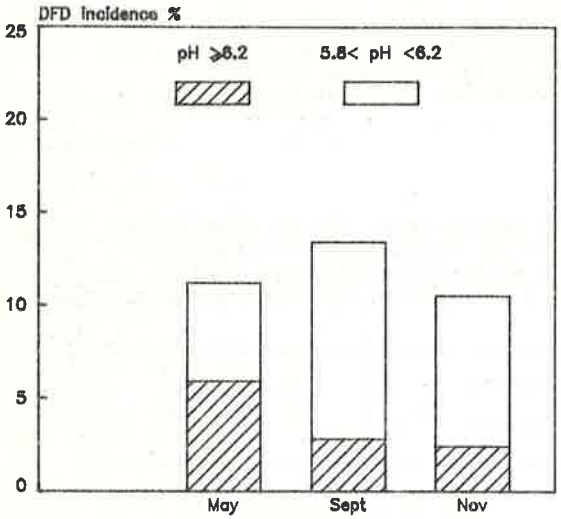

Figure 2. Seasonal variations in the incidence of DFD in M. longissimus dorsi in electrically stimulated young bulls.

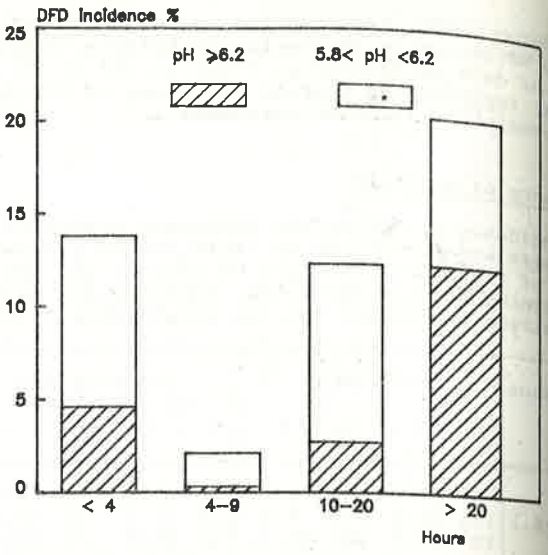

Figure 3. Influence of time in lairage on the incidence of DFD in M. longissimus dorsi in electrically stimulated young bulls.

The influence of the time of lairage at the abattoir has been shown to be one of the most important factors in the formation of DFD meat (Duchesne, 1978; Augustini et al, 1979). In the present investigation a lairage period of 4-9 hours showed the lowest incidence of DFD (Figure 3). However, from our data and due to the experimental design it is not possible to give an exact estimate of the most beneficial time in lairage. A closer study of the combined effects of lairage design and lairage time on the incidence of DFD is under way.

In this investigation distance and/or duration of transport did not show any significant influence on the incidence of DFD.

CONCLUSIONS

The incidence of DFD in the present investigation was high compared to data from other countries as reported in literature. The high incidence of DFD observed particularly in young bulls points out the necessity of handling these animals with special care. The lairage time should be kept short, but slaughter immediately on arrival at the abattoir should be avoided.

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