Effect of pre-slaughter handling of young bulls on dark cutting character in various muscles

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Introduction

In order to find factors influencing the formation of dark cutting beef and eliminate it as far as possible several environmental factors were studied: physical exercise /Bergström et al., 1967/, transport from long distance /Nestorov et al., 1972/, mixing strange animals /Fischer and Augustini, 1979; McVeigh and Tarrant, 1980./. Recently, results of comprehensive studies /Tarrant, 1980; Puolanne and Aalto, 1980/ have emphasized the importance of pre-slaughter penning conditions - mixing strange bulls caused a high incidence of dark cutting carcasses because of the continual fighting /Tarrant, 1980; Puolanne and Aalto 1980/. Glycogen depletion takes place in a short time, while recovery requires several days /Mc Veigh and Tarrant 1980/. To avoid the fight during inadequate rest of young bulls Katsarov /1978/ suggested slaughter of "freely" reared bulls immediately after transport. Fischer and Augustini /1979/ also found glycogen depletion during rest period of 48 hrs rather than by transport even under elevated environmental temperature. Wichlacz et al. /1979/ reported similar results, high incidence of dark cutting m. longissimus dorsi was found in the case of bulls rested for 3 days, which were prevented by sugar feed /molasses/. Puolanne and Aalto /1980/ suggested, that keeping bulls fixed in single pens during rest period resulted lower incidence of dark cutting beef.
Considering the various situations existing in farms and industry, there is a need for further information concerning the management of animals before slaughter.
In this study the effect of two pre-slaughter handling methods were compared on the incidence and degree of dark cutting character in various muscles.

Materials and Methods

Experiment 1.

13 Hungarian Red Spotted bulls /17 months old/ reared together in a covered house tied in single boxes were transported on lorry from 100 km distance to the slaughterhouse. Animals were fasting for 24 hrs before transport. After unloading the bulls slaughter started. Captive bolt stunning was used. Slaughter of the whole group required appr. 2,5 hrs. Animals were waiting untied in a semi-open pen until slaughtered.

Experiment 2.

16 Hungarian Red Spotted bulls /17 month old/ reared and transported under the same conditions as described above /Experiment 1./ were penned in a semi-open yard during a rest period of 2 days. Animals were located in rows along the rail and tethered. Animals were fasting for 2 days before slaughter.
Both experiments were carried out in winter time /January, February/.

Determination of ultimate pH

At 36 hrs post mortem pH was measured by INDU-NORM digital pH-meter equipped with combined glass electrode which was directly inserted to the muscles. pH was measured in the following muscles: m. longissimus dorsi /11.-12.rib/ /LD/, m. adductor /AD/, m. semitendinosus /ST/, m. semimembranosus /SM/, m. biceps femoris /BF/, m. rectus

femoris /RF/, m. psoas major /PM/, m. infraspinatus /IS/, m. trapesius cervicalis /TC/, m. longus colli /LC/.

Results and Discussion

In the first group /Experiment 1./, when bulls were slaughtered shortly after unloading dark cutting muscles were found in carcasses of bulls which were waiting for app 1 hr untied before slaughter /Fig. 1/. As the time advanced, LD ST and AD showed elevated pH_u /> 6.0/. After further waiting dark cutter character tended to be more frequent among further large muscles of hindquarter /SM, BF/ and even in the muscles of forequarter /IS, TC/. When incidence of dark cutting muscles /$pH_u \geq 6.0$/ whithin the same carcasses was related to the duration of waiting /13 min/animal/, a significant 0.65 correlation coefficient was obtained $P < 0.05$. This results are in accordance of the experience described by McVeigh and Tarrant /1980/ who gave evidence of rapid depletion of glycogen in LD under stressful conditions. In the group of bulls slaughtered after 2 days of rest while animals were tethered /Experiment 2./ dark cutting carcasses /LD $pH_u \geq 6.0$/ were less frequent /25 %/ compared to the first grup /53,8 %/. In the group of rested animals no significant correlation was found between incidence of dark cutting muscles within carcasses and the sequence of bulls slaughtered /Fig. 1/. However, more muscles showed elevated pH_u in rested group whithin dark cutting carcasses as defined by LD $pH_u \geq 6.0$/.

Fig. 2. presents the pH_u patterns of ten muscles within dark cutting /LD $pH_u \geq 6.0$/ and normal carcasses/LD $pH_u < 6.0$/ in both rested and non rested groups. Data were evaluated by three-way analysis of variance /quality group, pre-salughter treatment, muscles/. Significant effects were obtained of all these factors and their interactions also showed significant effects. As a result of quality groupx pre-salughter treatment interaction a higher mean value for pH_u was found in rested dark cutting /6.13/ than in the non-rested dark cutting group /5.98/ due to the more general depletion of glycogen which resulted in high pH_u in the majority of muscles examined.

Contrary to the non-rested group, where LC muscles /neck/ never showed elevated pH_u in dark cutting carcasses, in the case of long term stress, this muscle frequently exhibited elevated pH together with LD and ST. The latter muscles are considered to be the most liable muscles to formation of dark cutting character. /Tarrant, 1976., Tarrant and Sherington,1980, Puolanne and Aalto,1980/. Our experience confirmed these results, since LD, ST and also AD showed the highest pH pH_u and the most rapid formation of dark cutting character.

Similarly to adrenalin administered heifers which showed unusual pH_u pattern of 13 muscles /Tarrant and Sherington, 1980/, in rested group muscles of forequarter and RF showed elevated pH_u /6.0-6.1/ while in the other ones low pH_u values were found /Fig. 1., 14. and 16. animal/.
It is suggested from our results, that LD does not seem to be a good indicator regarding the whole carcass or other primal cuts since distribution of dark cutting muscles whithin carcass depends on the pre-slaughter handling method.

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Sequence of bulls slaughtered

	1	2	3	4	5	6	7	8	9	10	11	12	13
LD					X		X		X	X	X	X	X
AD					X		X		X	X	X	X	
ST					X		X		X	X	X	X	X
SM									X	X	X		
BF									X	X	X	X	
RF									X				
PM									X				
IS											X	X	
TC					X						X		
LC													
t	NON				RESTED								

n = 13

	1	2	8	10	14	16
	X	X	X	X		
		X	X	X		
	X	X	X	X		
	X	X	X	X		
	X	X	X	X		
	X	X				X
			X			
	X	X			X	X
			X			X
	X		X	X		
	R	E	S	T	E	D

n = 16

Fig. 1 Incidence of dark cutting character /$pH_u \geq 6.0$/ among ten muscles as influenced by two pre-slaughter handling methods and the sequence of bulls slaughtered /X = durk cutting muscle/

/Non rested group: Exp. 1., rested group: Exp.2./

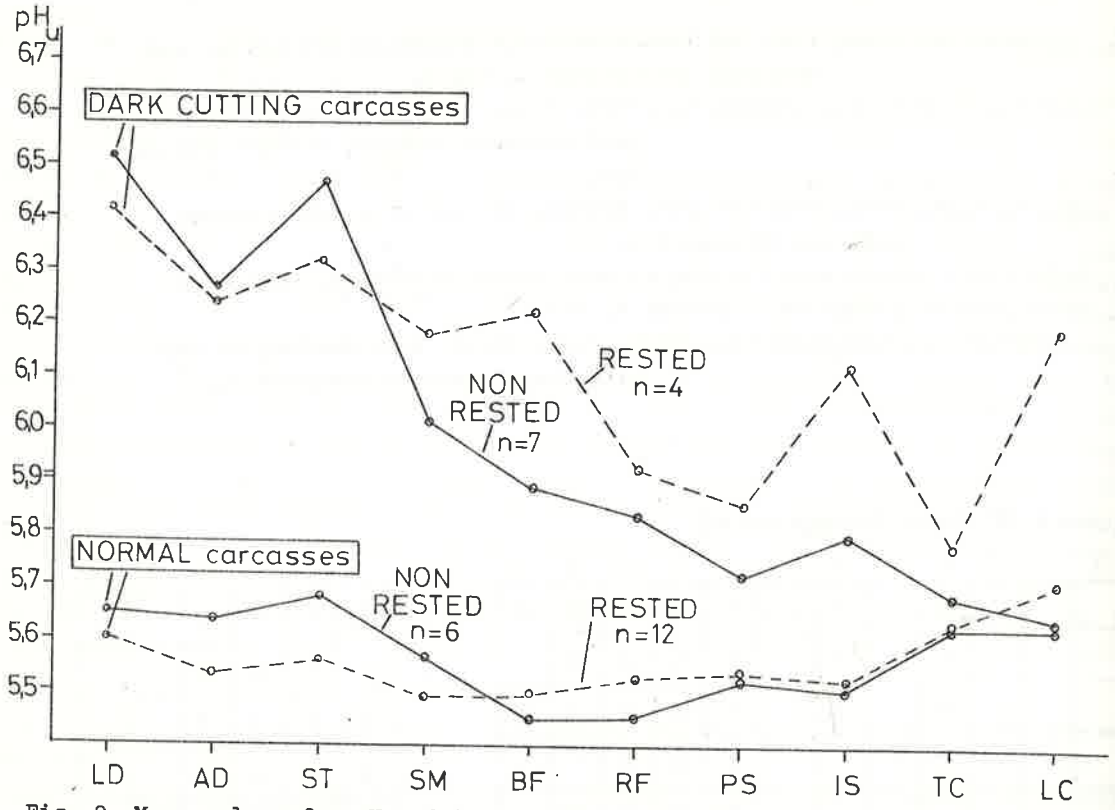

Fig. 2 Mean values for pH_u of ten muscles in the groups of dark cutting /LD pH $\geq$ 6.0/ and normal carcasses /LD pH < 6.0/ as influenced by two pre-slaughter handling methods