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Effect of Preslaughter Bull Handling on Ante Mortem Muscle Glycogen and Post Mortem pH and Glycogen Level
(short communication)

Summary

Fortythree bulls (13 Holstein, 12 crosses Holstein x Belgium Blue, 9 Slovak Pied and 9 crosses Slovak Pinzgauer x Piemontese) were taken in this experiment. Thirteen were stressed by mixing overnight before slaughter. Muscle values were analysed for glycogen ante mortem (M. semitendinosus), glycogen and pH post mortem (1h, 3h, 48h) from logissimus dorsi. The ante mortem and post mortem (1h, 3h) muscle glycogen concentration was depleted ($P<0.01$) in all stressed bulls. Differences ($P<0.01$) were found also in pH (48h). Significant correlations ($P<0.01$) between ante mortem and post mortem (1h, 3h) muscle glycogen respectivelly and ultimate pH supported the possibility to measure of stress and to predict carcass ultimate pH of bulls.

Key words: bulls, stress, muscle, glycogen and pH

Zusammenfassung

Titel der Arbeit: **Einfluß von Streß vor der Schlachtung auf ante mortem Muskelglykogen, post mortem pH und Glykogengehalt bei Bullen** (Kurzmitteilung)
Von dreiundfünfzig Mastbullen (13 Holstein, 12 Kreuzung Holstein x Belgium Blau, 9 Slowakisches Fleckvieh und Kreuzung Slowak Pinzgauer x Piemontese) wurden Muskelproben des *M. longissimus dorsi* von Glykogen ante mortem (*M. semitendinosus*), Glykogen und pH post mortem (1h, 3h, 48h) bestimmt.
Der Gehalt an Glykogen ante mortem und post mortem (1h, 3h) war in allen gestreßten Bullen vermindert. Unterschiede ($P<0.01$) bestanden auch beim pH (48h p.m.). Signifikante Korrelationskoeffizienten zwischen Messungen des Glykogengehalts (ante mortem und post mortem) und End-pH post mortem unterstützen die Möglichkeit, die Stressbelastungsfähigkeit und den End-pH-Wert des Fleisches vorherzusagen.

Schlüsselwörter: Bullen, Streß, Muskel, Glykogen, pH-Wert

Introduction

Domestic animals often experience physiological insults when they are transported and handled. Transport and handling stress could reduce carcass yield, degrade well-being and meat quality. The impact of transport and handling stress on meat quality variables including the rise of low glycogen meat and high pH occurence collectivelly reffered to as dark cutting or dark-firm-dry (DFD) meat (LACOURT and TARRANT, 1985; TARRANT, 1989; ZEMANOVA et al., 1987; MOJTO et al., 1991). Especially mixing of animals is known to contribute to dark cutting (LACOURT and TARRANT, 1985, SANZ et al., 1996).

Ante mortem stress entails important modifications in post mortem biochemistry of muscle and meat quality. The major effect is exerted through its influence on mobilisation of musle glycogen stores. If these are reduced or depleted before or at slaughter the extent of post mortem acidification is consequently reduced (WARRIS, 1990; SANZ et al., 1996). Ultimate pH in post mortem bovine muscle may vary between 5.4 and 7.2, showing a direct relationship with stress intensity. The negative effect on meat characteristics of high ultimate pH caused by stress, due to mixing different male types of cattle, was recently clearly demonstrated (SANZ et al., 1996; BELTRAN et al., 1997).

The aim of this study was to examine the glycogen content ante mortem before slaughter and pH and glycogen level after slaughter of unstressed and stressed cattle beefs.

Materials and Methods

Animals, housing and slaughtering

The animals used in the experiment were 13 Holstein, 12 Holstein x Belgium blue, 9 Slovak bunt and 9 Slovak Pinzgauer x Piemontese bulls, weighing 550 kg. They were fed on supplemented forage diets.

The animals (total 43) were tying housed and divided into the group A (n=30) tying housed and group B (n=13) loose housed (mixed) during night before slaughter. At the abattoir, the animals (group B) were kept overnight and had access to water but not food. Control (group A) and stressed animals (group B) were slaughtered at the Institute abattoir.

Sampling and analytical techniques

Just before slaughter, biopsy samples (approx. 1g) of semitendinosus muscle (ST) were obtained using efficient non-stress spring loaded biopsy instrument (Biotech, Nitra).

Samples of longissimus dorsi musle (LD) were also taken after slaughter (1h, 3h and 48h) directly frozen in liquid nitrogen for glycogen analyses (DREILING et al., 1987).

pH was measured in the longissimus muscle (13th rib) using a probe type combined electrode and portable pH meter (Radelkis, Hungary).

Differences between the means were assessed for statistical significance using an unpaired Student t-test. Correlations between values were also calculated.

Results and Discussion

As follows from the results (Table 1) of glycogen level ante mortem (just before slaughter) and early post mortem (1h and 3h) we received significant differences ($P<0.05$) of glycogenolysis between the experimental groups.

It was introduced (LACOURT and TARRANT, 1985) adrenalin release causes a general glycogenolytic response throughout the skeletal musculature with glycogen depletion. Mixing of unfamiliar animals can precipitate such events as fighting and mounting and such activities deplete muscle glycogen, especially of the fast twitch

Table 1
Muscle Glycogen Content (µmol/g) and pH value of unstressed (A) and stressed (B) Bulls (Glykogengehalt des Muskels (µmol/g) und pH-Wert bei der Kontrollgruppe (A) und den gestreßten (B) Bullen)

Values/Animals	A		B		p
Ante mortem					
glycogen	60.85	11.34	33.31	10.24	**
Post mortem					
pH_1	6.69	0.15	6.69	0.29	-
pH_3	6.27	0.34	6.71	0.37	-
pH_{48}	5.66	0.24	6.70	0.25	**
glycogen 1h	55.93	12.85	22.46	8.87	**
glycogen 3h	51.88	10.03	16.78	4.84	**
glycogen 48h	17.43	7.28	18.31	4.42	-

** P<0.01

fibers. In agreement with SANZ et al. (1996) our results supported the idea the main cause of lower glycogen level ante- and early post-mortem and higher ultimate pH (DC condition) was due to physical and emotional stress of mixing unfamiliar bulls at abattoir overnight. Ante-mortem stress entails important modifications in post-mortem biochemistry of muscle. If the muscle glycogen stores are reduced or depleted at slaughter the extent of post mortem acidification is consequently reduced (WARRIS, 1990). Ultimate pH in post-mortem bovine muscle may vary between 5.4 and 7.2, showing a direct relationship with stress intensity (BELTRAN et al., 1997). As follows from our results (Table 2) we received significant ($P<0.01$) correlation between glycogen level ante- and early post-mortem (1h, 3h) and ultimate pH (pH_{48}). Correlations with three-hour post-mortem muscle pH (pH_3) were not significant ($P>0.05$). The results are in agreement with SHACKELFORD et al. (1994), they showed also lower correlations of pH_3 with pH_u and tenderness and pH_3 was not enough effective in grouping stressed and unstressed animals in our experiment.

Table 2
Correlations between glycogen level and pH values of control and experimental bulls (A+B; n=43) (Korrelationkoeffizienten zwischen Glykogengehalt und pH-Wert aller Bullen)

	Number of value						
	1	2	3	4	5	6	7
1 pH_1	-	0.58*	-0.07	-0.06	-0.01	0.06	0.07
2 pH_3		-	-0.19	-0.20	-0.23	-0.13	0.24
3 pH_{48}			-	-0.67**	-0.73**	-0.78**	0.04
4 glycogen (ante mortem)				-	0.60**	0.70**	-0.04
5 glycogen (1h)					-	0.81**	-0.01
6 glycogen (3h)						-	0.02
7 glycogen (48h)							-

* P<0.05; ** P<0.01

In conclusion, the glycogen level ante-mortem (just before slaughter) and early post-mortem (1h, 3h) was good predictor for assessing handling stressors and carcass ultimate pH (pH_{48}) of bulls.

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