

## EFFECT OF REST PERIOD IN LAIRAGE ON MEAT QUALITY OF SIMMENTAL BULLS AND HEIFERS

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### Summary

In recent years a major problem in the beef chain production, which can lead to economic losses has been a frequent occurrence of dark, firm, dry beef. Consumers prefer a light pink to bright red colour and they will strongly reject dark coloured beef, believing that it is from old or sick cattle or that it is badly contaminated. The aim of this research was to examine the effect of rest period in lairage on the quality of Simmental bulls and heifers. The study was conducted on 400 cattle (200 bulls and 200 heifers), aged from 13 to 16 months. The cattle were divided in two groups; the first group rested for 18 hours in lairage prior to slaughter, while the second group (unrested) was taken to slaughterline immediately after being unloaded. Quality indicators pH, EC and meat colour values were measured 24 hours post-mortem. Heifers had significantly lower muscle pH<sub>24</sub>, EC value and higher L\* and b\* value, while bulls had significantly higher parameters pH<sub>24</sub> and EC value (P<0.001). Bulls rested in lairage had significantly poorer pH<sub>24</sub>, L\*, b\* and h\* value compared with unrested bulls, while rested heifers had significantly better pH<sub>24</sub>, L\* and h\* value, compared with unrested heifers (P<0.05). Our results indicate that the rest period in heifers could have a beneficial effect on beef quality, while in bulls rest period is not recommended.

Key words: *beef, rest period, quality indicators, colour*

### INTRODUCTION

During transfer to the slaughterhouse cattle can be exposed to various stressors such as fast or forced movements, exertion, jostling, breakdown of the social group, strange environment, rough treatment (during loading and unloading), novelty, track movement, noise, vibrations, centrifugal force, climatic conditions, shortage of food and water (Shackelford et al., 1994; Grandin, 1997; Swanson and Morrow-Tesch, 2001; Broom, 2003; Marencić et al., 2009). When cattle is stressed, there is a rapid release of catecholamines (norepinephrine, epinephrine, dopamine) which result in glycogen depletion (Lacourt and Tarrant, 1985) causing lower rate of post-mortem lactic acid synthesis, high ultimate pH, undesirable colour, making such beef DFD. Tatum, (2007) reported that bulls and heifers react differently on stressful situation, due to difference in temperament, hormonal effect (endogenous hormonal level) and calpastatin activity. The rest period is the time needed by cattle to recover from stress arisen during displacement from farm to slaughterhouse. It appears that a rest period in lairage may partly restore lost glycogen in cattle. The rest period in lairage can be beneficial for cattle exhausted by long transportation to the slaughterhouse, but it can also cause unnecessary additional stress in cattle transported from much shorter distances. In cattle glycogen supplies can be restored in lairage, even if they are not fed (Warris et al., 1984). Mounier et al. (2006) found that a longer rest period in lairage lowers the ultimate pH (pHu) value. Knowles (1999) reports that a resting time of 24 hours, with feed and waters available, makes it possible to recover from the stress. Gallo et al. (2003) found that a prolonged lairage over 16 hours leads to an increase in ultimate pH and to DFD beef. Similar negative results on beef quality were found by Liotta et al. (2007) prolonging the resting time over 36 hours after long journeys. However, a pre-slaughter rest may cause additional stress to cattle, especially if cattle are mixed in new, mutually unknown groups while resting in lairage (Kenny and Tarrant, 1987). Incidence of DFD meat is a serious problem in beef production; hence the aim of this research was to examine the effect of pre-slaughter rest in lairage on the beef quality of Simmental bulls and heifers.

### MATERIAL AND METHODS

Two hundred (200) non-castrated Simmental bulls and two hundred (200) heifers, aged between 13-16 months, were used in the study. From farm to slaughterhouse cattle were unmixed, transported in groups of ten. The stocking density in a lorry was approximately 1.5 m<sup>2</sup>/cattle. Transport was conducted in early morning hours and lasted approximately 265 min. According to the rest period in lairage cattle were divided in two groups; the first group included 100 bulls and 100 heifers that were rested for 18 hours in lairage prior to slaughter, while the second group (unrested) included 100 bulls and 100 heifers which were taken to the slaughterline immediately after being unloaded. Cattle fasted, but had ad libitum access to water during the rest period. The stocking density in lairage was approximately 2 m<sup>2</sup>/cattle. The cattle were slaughtered according to a standard procedure. Carcasses were chilled under commercial condition at 4 °C for 24 hours.

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As quality indicators pH, EC and meat colour values were measured 24 hours post-mortem (plus 80 minutes bloom time) on the right side of *m. longissimus dorsi* removed from the area between 6<sup>th</sup> and 7<sup>th</sup> ribs. Concentration of hydrogen ions (pH) was determined with Euteh CyberScan pH 310 instrument. Electrical conductivity (EC) was determined with LF-Cotrol system instrument (Würthinger, Pettenbach, Austria) in millisiemens/cm (mS/cm). In order to evaluate the colour pattern, CIE (Comission Internationale de l'Eclairage) values were measured (L\* (Lightness), a\* (Redness), b\* (Yellowness), C\* (Chroma), and h\* (Hue) using Minolta Chroma Meter CR-410 (Minolta Co., Ltd., Japan) on a 50-mm diameter measurement area. The colour spectrum was determined under standard D65 illumination. Statistical analysis was carried out using the least square methodology of the GLM procedure (SAS, 1999), fitting a two-way model with a fixed effect of sex (2 levels: bulls and heifers) and rest period (2 levels: 18 hours rested and unrested). The meat samples were classified into 3 classes according to Buchter (1981): normal meat (pH<sub>24</sub> < 5.8), DFD suspected meat (pH<sub>24</sub> 5.8 to 6.2) and DFD meat (pH<sub>24</sub> > 6.2).

## RESULTS AND DISCUSSION

The average carcass weight of bulls was 354.98±37.02 kg., while the average carcass weight of heifers was 270.53±22.83 kg. During the fattening period of 13.70±1.37 months, heifers had significantly lower average net weight gain 0.655±0.08 kg/d, compared with bulls whose average net weight gain was 0.759±0.07 kg/d, during 15.39±0.84 months of fattening period (P<0.001). According to E U R O P standard, in this study carcass classes E were dominant (52.5%) followed by carcass classes U (42.0%) and R (5.5%). Heifers produced carcasses with significantly higher fat score (3.27±0.52; 2.97±0.32), compared with bulls (P<0.001). These results confirm previous conclusions that heifers slow down in muscles gain earlier, and also start earlier to accumulate fat thickness, compared with bulls, whose higher final weight produced lower fat score. The effects of different rest period on meat quality of bulls and heifers are shown in Table 1.

Tab. 1: Least square mean (±S.E.) of pH, EC, muscle colours in terms of two different rest periods on Simmental bulls and heifers

Parameters	Sex	Rested	Unrested	$s \bar{X}$	Significance level
pH <sub>24</sub>	bulls	5.65 <sup>a</sup>	5.58 <sup>b</sup>	0.02	**
	heifers	5.54 <sup>a</sup>	5.59 <sup>b</sup>	0.01	***
EC	bulls	6.73	6.90	0.13	NS
	heifers	4.68	4.65	0.008	NS
L*	bulls	40.68 <sup>a</sup>	41.51 <sup>b</sup>	0.27	*
	heifers	43.87 <sup>a</sup>	43.43 <sup>b</sup>	0.15	*
a*	bulls	28.77	29.11	0.18	NS
	heifers	28.83	28.73	0.13	NS
b*	bulls	11.06 <sup>a</sup>	11.43 <sup>b</sup>	0.13	*
	heifers	11.78	11.64	0.09	NS
C*	bulls	30.83	31.29	0.21	NS
	heifers	31.15	31.14	0.15	NS
h*	bulls	20.89 <sup>a</sup>	21.33 <sup>b</sup>	0.14	*
	heifers	22.16 <sup>a</sup>	21.85 <sup>b</sup>	0.10	*

NS = not significant; \*(P<0.05); \*\*(P<0.01); \*\*\*(P<0.001)

Rest period in lairage had a significant influence on beef quality indicators in this study. The results are in line with several researchers who also found that rest period in lairage had significant effect on beef quality (Knowles, 1999; Kenny and Tarrant, 1987; Gallo et al., 2003; Mounier, 2006; Ferreira, 2006). In this study, bulls that were rested 18 hours in lairage had significantly poorer pH<sub>24</sub> (P<0.01) L\*, b\* and h\* value (P<0.05) compared with unrested bulls, while rested heifers 18 hours in lairage had significantly better pH<sub>24</sub> (P<0.001), L\* and h\* value (P<0.05), compared with unrested heifers (P<0.05).

Tab. 2: Effect of rest period on the frequency distribution of beef quality classes

Sex	Rest period	Normal meat (pH <sub>24</sub> < 5.8)	DFD suspected meat (pH <sub>24</sub> 5.8 to 6.2)	DFD meat (pH <sub>24</sub> > 6.2)	Sign. level
bulls	rested	88.50%	8.05%	3.45%	**
	unrested	97.70%	2.30%	-	
heifers	rested	97.66%	1.56%	0.78%	*
	unrested	92.97%	7.03%	-	

\*(P<0.05); \*\*(P<0.01)

As shown in Table 2. considerably higher proportion of DFD suspected meat and DFD meat was recorded in groups of bulls that were rested 18 hours in lairage, whereas the percentage of DFD suspected meat and DFD meat in groups of bulls that were slaughtered unrested remained significantly low level (P<0.01). In contrast to bulls, heifers that were kept

18 hours in lairage prior to slaughter had significantly lower incidence of DFD and DFD suspected meat, compared with unrested heifers ( $P < 0.05$ ).

Our results indicate that the pre-slaughter rest period in lairage had an adverse effect on bulls beef quality in contrast to heifers' beef where the pre-slaughter rest period had a beneficial effect. The authors think that such adverse results on the pre-slaughter rest period in lairage between bulls and heifers were primarily caused by the difference in their temperament and reaction on pre-harvest stress. Bulls are animals with more agitated behaviour, and such behaviour usually intensifies physical and psychological stressors which often lead to a decrease in muscle glycogen, causing lower rate of post-mortem lactic acid synthesis, high ultimate pH and undesirable colour, producing DFD beef. Wulf et al. (1997) also found that bulls were more temperamental than heifers. Tatum (2007) reported that cattle with more excitable temperaments had higher final muscle pH measurements, dark muscle colour, higher calpastatin activities, higher shear force values, and lower sensory panel ratings for tenderness and flavour, compared with cattle having calmer temperaments. Gruber et al. (2006) found that cattle exhibiting calm behaviour had lowest blood lactate levels, whereas agitated behaviour of cattle could affect pH value.

## CONCLUSION

The results indicate that an 18 hours rest period in lairage prior to slaughter is not recommended for bulls, due to bulls temperament and agitated behaviour, while in heifers the same rest period could have beneficial effects on beef quality indicators, due to heifers' calm behaviour.

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