

# EFFECTS OF RACE AND AGE AT SLAUGHTER ON CARCASS TRAITS AND ON PORK QUALITY

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Keywords: Race, age, carcass pork quality, cathepsin

## Introduction

Many factors such as genetics, slaughter age, environmental factors and nutrition play a substantial role in the production of acceptable pork quality. Moreover, initial and ultimate pH (pH<sub>u</sub>), color, intramuscular fat (IMF), subcutaneous fat, firmness, and drip loss of the meat can be used to estimate the pork quality (Virgili *et al.*, 2003). High drip loss has an unattractive appearance and limits the yield in further processing, which leads to loss of sales. The presence of higher IMF levels may increase water-holding capacity and juiciness in the meat and thus enhance consumer acceptance. Cathepsin proteases are located in the lysosomal compartments play a role in myofibril degradation and cathepsin activity may vary in different pig breeds (Toldra and Flores, 1992). The objectives of the present study were to investigate the influences of pig races (Landrace, Duroc and Hampshire) at different slaughter ages (6, 9 and 12 months) on pork quality and cathepsin activity.

## Materials and Methods

**Genetic material, slaughter and carcass evaluation.** A total number of 82 female pigs were used in this study (Table 1). Whole carcass data including pH, backfat and loin depths and IMF were recorded within 45 min *post mortem*. The initial and the ultimate pH (pH<sub>45</sub>, pH<sub>5</sub> and pH<sub>24</sub>) of the *semimembranosus* muscle (SM) were recorded using a portable pH meter (Knick-Portamess 751, Calimatic, Germany) at 45 min, 5 h and 24 h post-mortem. At 4 and 5 days after slaughter a small sample of the *Longissimus dorsi* (LD) were removed, frozen in N<sub>2</sub>(l) and stored at -80°C until cathepsin activity analyses were performed. Drip loss and meat color were measured in duplicate from LD chops (Otto *et al.*, 2004) and using the Minolta Chromameter to obtain L\*, a\*, and b\* values, respectively.

**Table 1.** Effect of race and age on meat quality characteristics and composition of LD and SM muscles.

Race	Landrace			Duroc			Hampshire		A	R	A*R
Age (months)	6	9	12	6	9	12	6	12			
Number (n)	17	17	17	3	9	8	8	3			
Hot carcass wt, kg	98.19	147.3	177.19	83.17	126.31	133.39	90.79	175.63	***	***	***
meat %	59.71	52.35	46.71	56.33	50.89	51	56.75	51.33	***	ns	***
pH <sub>45</sub>	6.33	6.31	6.26	6.53	6.64	6.58	6.51	6.43	ns	***	ns
pH <sub>5</sub>	5.74	5.62	5.76	6.15	5.97	6.03	5.92	5.83	ns	***	ns
pH <sub>24</sub>	5.49	5.44	5.48	5.54	5.49	5.52	5.51	5.72	ns	*	*
Color score	35	33.29	34.53	40.33	38.67	36.13	38.38	37.33	ns	***	ns
Lightness <sup>2</sup> (L*)	47.74	45.2	43.74	47.32	44.73	41.93	46.52	42.36	***	*	ns
Redness <sup>2</sup> (a*)	7.32	8.48	10.35	7.84	9.05	10.29	9.17	9.52	***	*	*
Yellowness <sup>2</sup> (b*)	3.53	3.57	4.27	4.07	3.11	2.3	4.52	1.99	ns	*	***
Subcutaneous fat 1	11.69	21.7	28.18	11.4	22.53	21.8	15.1	21.47	ns	***	**
Subcutaneous fat 2	13.84	26.13	31.33	12.2	24.31	27.1	16.9	31.6	*	***	ns
Fat (IMF)	1.35	1.62	2.24	2.42	3.95	3.87	1.44	2.89	***	***	ns
Water content %	72.80	69.90	68.29	71.67	67.03	66.99	71.88	69.17	***	**	ns
Protein %	23.24	23.37	23.32	22.73	22.24	21.86	21.64	22.47	ns	***	ns

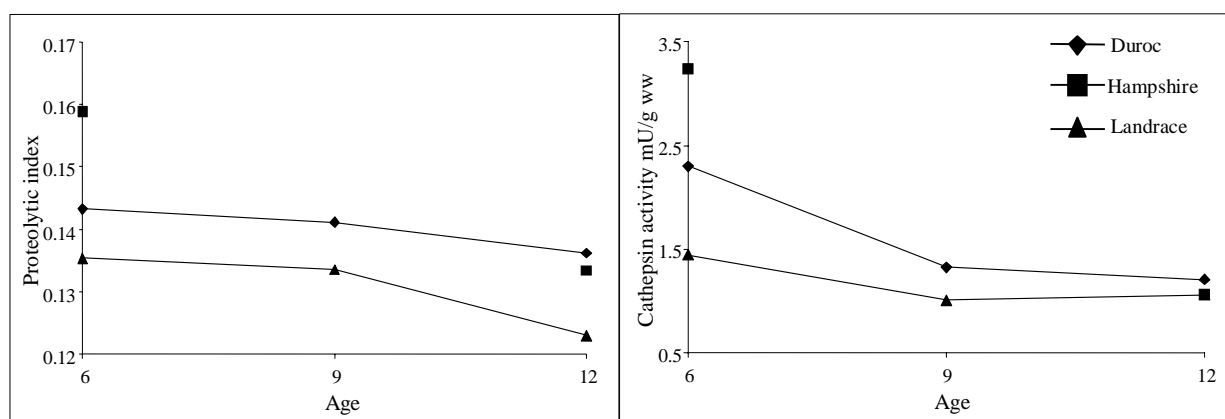
All numbers are mean values. (n): total number of female pigs used in this study, Lightness<sup>2</sup> (L\*): Measure of darkness to lightness (larger values indicates a lighter color); Redness<sup>2</sup> (a\*): C redness (larger values indicates a redder color); Yellowness<sup>2</sup> (b\*): measures of yellowness (larger values indicates a more yellow color). A: age, R: race, ns: not significant, \* p< 0.05, \*\* p< 0.01, \*\*\* p< 0.001.

**Chemical and Statistical analyses.** Crude protein was determined by the Kjeldahl method and proteolytic index was calculated as percent ratio between nitrogen soluble in 5% trichloroacetic acid, determined by the Kjeldahl method after protein precipitation with trichloroacetic acid, and total nitrogen (NMKL 6:2003). The water content in the

pork was detected using the official AOAC method (AOAC 978.18). Cathepsin B + L activity was performed mainly as described in (Kristensen *et al.*, 2004). The data were evaluated statistically according to a general linear model with the following model terms: race, age, race×age, age×age, race×age×age, where race is a categorical variable (ANOVA variable) and age is a continuous variable (regression variable). The p-values to ensure that the unbalance problem is handled satisfactory were calculated along with false discovery rate (FDR) adjusted p-values (Langsrud *et al.*, in press). Principal component analysis was performed to illustrate the most important data variation based on mean values within the level combinations of race and age.

## Results and Discussion

There is a significant difference between the three races in IMF content with Duroc harboring more fat than Hampshire and Landrace in all age groups (Table 1). A significant effect of race could be observed on the pH measurements at 45 min, 5 and 24 h after slaughter. In addition, we observed a significant effect of age on color strength, with a more pronounced color in meat from the older pigs. A significant effect and interaction between both race and age on the proteolytic index and cathepsin B + L activity is also observed (Figure 1). For all races the highest activity was observed in the younger pigs. At 9 months the difference between races were not significant ( $p=0.071$ ) and at 12 months there was no difference in cathepsin B + L activity among the races. These data suggest that differences in meat tenderness among breed types may be explained partially by differences in proteolytic enzyme activity (Toldra and Flores, 1992).



**Figure 1.** Effect and interaction of race and age on the proteolytic index and cathepsin activity.

## Acknowledgements

We thank Mr. Jørgen Johansen and Mrs. Vibeke Høst for their technical assistance and discussion. This work was supported by a grant from the Norwegian Research Council (No 167942/110).

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