Influence of fasting time and feeding regime prior to slaughter on pork quality

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Abstract

The aim of this study was to investigate the effect of pre-slaughter fasting time, feeding regime and gender on meat quality of pigs. A total of 270 crossbred (LYLD) pigs were used for the study, which involved four fasting times (4 h, 17.5 h, 17.5 h + overnight lairage and 26.5 h + overnight lairage), two feeding regimes (ad-libitum and restricted) and two sexes (gilts and castrates). There was an equal distribution of feeding regime and sex within each fasting time. pH and drip loss of the *L. longissimus (LD)* were measured 45 h post mortem. Sensory evaluation was performed on samples that were vacuum packed and deep frozen for seven months. Prolonged fasting time prior to slaughter increased pH_{45h} and reduced drip loss significantly. The pH_{45h} was not affected of feeding regime or sex class. Drip loss was significant higher in gilts than in castrates on ad-libitum feeding. We found a strong tendency of improved tenderness by increased fasting time (P=0.053). Further we detected a significant improved tenderness in castrates compared to gilts, and on ad-libitum feeding compared to restricted feeding. The juiciness was significant higher in castrates than in gilts, while no effects of feeding regime and fasting time were registered. In conclusion we saw in this trial that prolonged fasting time of pigs prior to slaughter increases the $pH_{45\ h}$, reduces drip loss and tend to improve tenderness of the loin without any clear effects on juiciness. Further there are effects of sex on drip loss and both feeding regime and sex on tenderness and juiciness.

Introduction

The rate of post mortem energy metabolism plays an important role in the conversion of muscle to meat and is important for many different quality properties of fresh pig meat. As glycogen is broken down lactic acid accumulates and the muscle gradually acidifies. This lactic acid accumulation causes the pH of the muscle to decline after death. As pH falls and particularly if the pH fall is rapid while the carcass temperature is still high, muscle proteins denature and reduces their power to bind water. The myofibrillar proteins, actin and myosin, reach their isoelectric point and without any net electrical charge water is not bound to them anymore. Further the pH fall causes a reduction in interfibrillar spacing in the muscle giving a reduction in the ability to bind water (Offer, 1991). The amounts of muscle glycogen at the time of death is determining the rate and extent of glycolysis and thus the ultimate pH at 24 h (pHu) (Warriss, Bevis & Ekins, 1989) and further the colour and water-holding capacity (WHC) of meat (Bidner, Ellis, Witte, Carr & McKeith, 2004) A fasting period of 16-24 h is recommended in practice (Eikelenboom, Bolink & Sybesma, 1991) in order to reduce the volume of stomach content and the risk of microbial contamination. Results from studies dealing with the effect of fasting time on pHu are controversial. Many studies have showed that a prolonged fasting period before slaughter resulted in lower muscle glycogen and meat with a higher muscle pHu (Wittmann, Ecolan, Levasseur & Fernandez, 1994), while (Bidner et al., 2004) did not find any effect on pHu even after 60 h of fasting. (Bertol, Ellis, Ritter, McKeith & Hamilton, 2006) found a reduction in muscle glycogen in pigs fasted for 24 hrs and handled with high intensity, but not in fed pigs with the same handling intensity. Effect of fasting is dependent of other factors like feeding and pre slaughter handling practices (Faucitano et al., 2006). The aim of this study was to evaluate the effect of different fasting periods prior to slaughter on pH_{45}, drip loss and texture of *L. longissimus (LD)*. Another objective was to within the different fasting treatments to determine the combined effects of different feeding regimes prior to transportation to slaughter and of different sexes.

Materials and methods

A total of 270 slaughter pigs (135 gilts and 135 castrates) of the commercial Halothan gene negative Norwegian crossbreed Noroc ((Norwegian Landrace x Large White) sow and (Norwegian Landrace x Duroc) boar) were used in the trial. The pigs were allotted 8 – 10 pigs per pen with the same sex (gilts or castrates) in each pen in a 640 commercial confinement finishing facility. The pigs were fed a dry commercial grower-finisher diet at two different feeding regimes, restricted according to a feeding scale or ad libitum feeding. The pigs were transported approx. 1.0 hrs on a commercial trailer and slaughtered at commercial abattoir

over a period of 15 days at 4 slaughter days. In the lairage the pigs were randomly mixed with unfamiliar pigs. The pigs were stunned with CO_2 in a back loader group stunning system (COMI88, Butina APS, Denmark). Prior to slaughter the pigs experienced four different fasting times. The first group was fed at 6.30 in the morning and 1.5 hrs before delivery and kept in the lairage until 10:30 which led to a feed deprivation of 4 hrs before slaughter **(F4),** considered as not fasted. The second group was not fed in the morning but at 17:00 the day before slaughter at 10:30 which gave a feed deprivation of 17.5 hrs before slaughter **(F175).** The third group was fed at 6:30 in the morning, transported to the abattoir and kept in the lairage, fed at 14:30 and then slaughtered the following day at 8:00 which led to a feed withdrawal of 17.5 hrs **(FO175).** The fourth group was fed at 6:30 in the morning, transported to the abattoir and kept overnight in the lairage without any feeding and then slaughtered the following day at 8:00 which led to a feed withdrawal of 26.5 hrs **(FO265).** The pH was measured in the centre of LD at the last rib 5 cm off the midline with a Knick Portamess 751 Calimatic pH meter Berlin, Germany attached to a Mettler-Toledo InLab ® 427 insertion glass electrode (Mettler –Toledo, GmbH, Hackacker, Germany) at 45 hrs post mortem. Drip loss was determined at 45 hrs post mortem (pH_{45})on duplicate LD samples of 20 mm thickness using the DMRI EZ-DripLoss method (Christensen, 2003). Sensory analyses of muscle samples taken from the LD at the last rib vacuum packed and deep frozen for seven months, were conducted by a trained 10-member panel (Matforsk AS, Norway). Each sample was cut into 10-mm-thick slices, vacuum packaged, and heated for 1 h in a 75 °C water bath to a core temperature of 73 °C. Each sample was evaluated twice, in random order, for 18 sensory attributes including tenderness and juiciness. Each assessor evaluated the samples using a continuous scale and a computerized system for direct recording of data (Compusense Five, Compusense, Guelph, Ontario, Canada). The computer translated responses into numbers where 1 = no intensity and 9 = high intensity. The statistical analysis was carried out with Statistical Analysis System version 8.02 (SAS Institute, Cary USA). The General Linear Models procedure of SAS was used to analyse the variables pH_{45}, drip loss and sensory attributes. The model included the fixed effects of fasting time, sex, feeding regime and their interactions. Least square means were evaluated using the REGWQ option of SAS. Least square means were considered significantly different if $P<0.05$.

Results and discussion

The pH_{45} was significant higher in fasted gilts (F175, FO175 and FO265) than not fasted (F4), while in castrates the pH_{45} was significant higher in the group with the longest fasting time (FO265) than in the groups that experienced shorter or no fasting time (Table 1). This is in agreement with other studies concluding the increased feed withdrawal increases pHu due to a reduction in glycogen stores at the time of slaughter ((Eikelenboom et al., 1991; Partanen, Sijander-Rasi, Honkavaara & Ruusunen, 2007). A British study (Warriss, Brown, Adams & Lowe, 1990) found that when compared with animals fed ad. lib., pigs fed restricted had a lower pHu ($p<0.05$). In our experiment feeding regime prior to slaughter had no impact on pH_{45}. The drip loss was significant lower in the group with the longest fasting time compared to all the other groups with shorter fasting times for both feeding regimes (Table 2). This result agrees with many other studies concluding with reduced drip loss as a result of a fasting period before slaughter (Leheska et al., 2002; Eikelenboom et al., 1991). The gilts fed ad-libitum before slaughter had significant higher drip loss than the castrates, while no difference was detected between sexes on restricted feeding. These interactions between sex and feeding regime when looking at drip loss are difficult to explain, and need more investigation. However in general the negative correlation between pH_{45} and drip loss is quite clear. The effect on the sensory traits tenderness and juiciness is shown in Table 3. We found a strong tendency of improved tenderness by increased fasting time (P=0.053). Further we detected a significant improved tenderness in castrates compared to gilts, and on ad-libitum feeding compared to restricted feeding. The juiciness was significant higher in castrates than in gilts, while no effects feeding regime and fasting time were registered. It has been considered that a product with a high degree of drip loss would tend to be less tender and juicy (Huff-Lonergan, Baas, Malek, Dekkers, Prusa & Rothschild, 2002) which supports the results of our study.

Table 1. LSmeans for pH_{45} in *M. Longissimus Dorsi* of gilts and castrates

	Feeding regime		Fasting time				Feeding regime	Fasting time
	Restricted	Ad.lib.	F4	F175	FO175	FO265	*P-value*	*P-value*
Gilt	5.56	5.55	5.49b	5.56a	5.59a	5.57a	0.72	<0.0001
Castrate	5.53	5.55	5.51b	5.53b	5.53b	5.58a	0.41	<0.0036

Different letters within a row indicates significant (P<0.05) difference between values.

Table 2. LSmeans for drip loss of *M. Longissimus Dorsi* at restricted and ad.lib. feeding

	Sex		Fasting time				Sex	Fasting time
	Gilt	Castrate	F4	F175	FO175	FO265	*P-value*	*P-value*
Restricted	3.67	3.61	3.91ab	4.43a	3.53b	2.67c	0.78	<0.0001
Ad.lib.	3.92a	3.21b	4.48a	3.67b	3.59b	2.52c	0.0033	<0.0001

Different letters within a row indicates significant (P<0.05) difference between values.

Table 3. LSmeans values for tenderness and juiciness of *M. Longissimus Dorsi*

	Sex		Feeding regime		Fasting time				Sex	Feeding regime	Fasting time
	Gilt	Castrate	Restricted	Ad.lib.	F4	F175	FO175	FO265	*P-value*	*P-value*	*P-value*
Tenderness	3.73b	4.18a	3.82b	4.04a	3.72	3.95	4.02	4.14	0.01	<0,0001	0.053
Juiciness	3.02b	3.34a	3.12	3.23	3.06	3.15	3.26	3.24	<0.0001	0.15	0.24

Different letters within a row indicates significant (P<0.05) difference between values.

Conclusions

Prolonged fasting time of pigs prior to slaughter increases the $pH_{45\,h}$, reduces drip loss and tend to improve tenderness of the loin without any clear effects on juiciness. Further there are effects of sex on drip loss and both feeding regime and sex on tenderness and juiciness.

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