Influence of different transport times on the meat quality of pigs of known pedigree

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Introduction

Energy reserves in pig muscle at the point of slaughter are extremely important for the way in which a pig can express its heritable pre-disposition for meat quality (Nielsen, 1980). Thus, high energy reserves are a pre-requisite when pigs are to be tested for meat quality in breeding work. For this reason all pigs to be tested for meat quality in Denmark are subjected to a standardised pre-slaughter treatment (Barton, 1974). This treatment is short and considerate and conserves energy reserves to the greatest possible extent:

1) access to feed until collection, no weighing on the day of slaughter,

2) loading using a pig elevator,

3) transport for 40 minutes in a lorry equipped with non-skid floors, partitions and a mechanical ventilation system,

4) driving directly from the lorry to the stunning area without the use of an electric goad or any other means of force,

5) electrical stunning on the floor, 70-80 V.

In recent years there have been increasing problems in maintaining all aspects of this standardised treatment for all testing stations, and these problems would be greatly reduced if slaughter could be concentrated on fewer abattoirs. However, this is not possible with the 40 minutes transport time used at present. The aim of this experiment was to investigate whether the transport time could be increased to 80 minutes without affecting meat quality to any great extent.

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Methods and materials

The experimental material consisted of 468 Danish Landrace pigs. All the pigs came from a single producer, who supplied on average 30 pigs a week. The pigs were moderately fed on the day of slaughter. On loading the pigs available were divided into three approx. equal groups, which were placed in each of the three compartments on the lorry. The producer used three boars, and as far as possible progeny from these three were divided equally between the three experimental groups. The lorry was equipped with an elevator, mechanical ventilation and a non-skid floor. The pigs were off-loaded three times corresponding to 30 minutes transport (rear compartment), 55 minutes transport (middle compartment) and 80 minutes transport (front compartment). They were slaughtered immediately on arrival using electrical stunning on the floor (60 V). This procedure was repeated for 15 separate weeks during the period November 1980 to March 1981.

The day after slaughter all pigs were investigated for meat quality i.e. PSE/DFD-status as follows:

1) Colour (reflectance at 535 nm) in uncured biceps femoris and cured l. dorsi,

2) Water binding capacity (soluble sarcoplasmic and myofibrillar proteins) in biceps femoris and l. dorsi,

3) pH_2-values in seven muscles (semimembranosus, biceps femoris, quadriceps, l. dorsi, semispinalis capitis, serratus ventralis and triceps brachii),

KK-index values were calculated using the above colour values as well as the pH_2-values in l. dorsi, biceps femoris and semispinalis capitis muscles. The KK-index is the meat quality estimation used at present in Denmark in pig progeny testing. It is an estimate of the PSE/DFD status of the pig carcass. The KK-index has a scale from 0.1 to 10.0, where 10 is best. Low KK-index values are always an indication of poor meat quality, and can be due to either PSE- or to DFD-meat (or both). However, with the short standardised pre-slaughter treatment used in Denmark, low KK-index values are usually an indication of PSE-meat.

The results were investigated using an analysis of variance with transport time, pedigree (boar) and sex (gilt or castrate) as variables.

Results

The main results on the analysis of variance were shown in Table 1. In this table means with different superscripts within transport time, pedigree or sex are significantly different (p at least < 0.05). It can be seen that both transport time and pedigree affected meat quality, whereas sex did not.

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Table 1 Least square means for the various experimental groups

Characteristic	Transport time (minutes)			Boar No.			Sex	
	30	55	80	3	4	5	Castrate	Gilt
No. of pigs	145	154	158	199	158	100	249	208
Colour-uncured biceps femoris	15.82 c	15.33 b	14.18 a	14.99 b	15.92 c	14.42 a	15.28	14.94
Colour-cured l. dorsi	12.94 b	12.52 ab	12.22 a	12.51 a	12.92 b	12.26 a	12.65	12.48
pH_2-l. dorsi	5.45 a	5.46 a	5.50 b	5.47	5.47	5.48	5.48	5.47
pH_2-biceps femoris	5.50 a	5.51 a	5.54 b	5.53	5.52	5.51	5.52	5.52
pH_2-semispinalis capitis	5.87 a	5.92 b	5.99 c	5.93	5.93	5.92	5.91	5.94
KK-index values	7.35 a	7.57 a	7.80 b	7.62 b	7.30 a	7.80 b	7.49	7.66
pH_2-semimembranosus	5.47 a	5.47 a	5.49 b	5.50 c	5.48 b	5.46 a	5.48	5.48
pH_2-quadriceps	5.59 a	5.62 b	5.66 c	5.64	5.62	5.62	5.63	5.62
pH_2-serratus ventralis	5.84 a	5.90 a	6.00 b	5.92 a	5.93 b	5.90 ab	5.91	5.92
pH_2-triceps brachii	5.63 a	5.64 b	5.69 c	5.64 b	5.67 a	5.65 b	5.65	5.66
Water binding capacity, l.dorsi	0.165 a	0.173 b	0.181 c	0.178 b	0.161 a	0.181 b	0.174	0.172
Water binding capacity, b.femoris	0.162 a	0.167 b	0.174 c	0.170 b	0.160 a	0.173 b	0.168	0.167

Higher colour values = lighter colour; higher water binding capacity values = better water binding capacity

Influence of transport time

In spite of the fact that the differences in transport time used in this experiment were not particularly great, the results clearly show that meat quality was highly affected by transport time - the shorter the time, the lighter the colour, the lower the pH_2-value, the lower the KK-index value and the poorer the water binding capacity. The incidence of PSE-meat was thus highest with 30 minutes transport, while the incidence of higher than normal pH_2-values was highest with 80 minutes transport:

Description			Transport time (minutes)		
			30	55	80
% PSE	l. dorsi		24.2	14.9	6.4
	biceps femoris		12.4	6.5	0.6
% pH_2	l. dorsi	$\geq$ 5.70	0	1.3	5.1
	biceps femoris	$\geq$ 5.90	0	0	1.3
	semispinalis capitis	$\geq$ 6.30	1.4	1.9	8.2
	semimembranosus	$\geq$ 5.80	0.7	0	0.6
	quadriceps	$\geq$ 6.10	1.4	0	1.9
	serratus ventralis	$\geq$ 6.10	0.7	3.2	19.6
	triceps brachii	$\geq$ 5.90	1.4	1.3	7.0
% KK-index values < 6.5			20.5	12.0	10.0

The PSE-incidence was based on water binding capacity measurements - values $\leq$ 0.125 = PSE

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As previously mentioned, KK-index values are an indication of the PSE/DFD-status of the pig. The percentage of pigs with an unacceptable KK-index (< 6.5) did not fall nearly as much between 55 and 80 minutes transport as it did between 30 and 55 minutes, due to the fact that the fall in PSE-frequency was equalised to a great extent by an increase in DFD-frequency. In fact all pigs with unacceptable KK-index values were PSE with 30 minutes transport, whereas only 56% of the pigs with unacceptable KK-index values were PSE with 80 minutes transport.

Influence of pedigree (boar)

The three boars used in this experiment were different with respect to average meat quality. Boar No. 4 had the lightest colour, the lowest KK-index and the poorest water binding capacity, while boar No. 5 had the darkest colour, the best KK-index and the best water binding capacity. Boar No. 3 lay between these two, although nearest to boar No. 5.

The three boars were not only different with respect to average meat quality - their progeny also reacted differently to increasing transport time:

Boar No.	Transport time minutes	PSE-pigs %	DFD-pigs %
3	30	23.9	0
	55	6.5	0
	80	0	1.7
4	30	44.4	0
	55	29.6	0
	80	17.0	0
5	30	8.1	0
	55	8.8	0
	80	2.5	0

PSE-incidence based on water binding capacity in l. dorsi and biceps femoris
DFD-pigs = pigs with at least five of the seven muscles with higher than normal pH_2-values

Progeny from boar No. 3 (the middle boar) showed a great reduction in PSE-frequency with increasing transport. If progeny from this boar have a suitably long pre-slaughter treatment, then the PSE-incidence will be minimal.

Progeny from boar No. 4 (the poorest boar) showed some reduction in PSE-incidence with increasing transport but even with 80 minutes transport 17% of the pigs were PSE.

Progeny from boar No. 5 (the best boar) showed a slight reduction with increasing transport, but the PSE-incidence was low for all transport times.

Influence of sex

As expected, there were no differences between gilts and castrates for any of the meat quality characteristics investigated.

Discussion

It is the difference between 55 and 80 minutes transport which is of practical importance in this experiment. The results show that increasing transport time from 55 to 80 minutes will halve the PSE-incidence. If KK-index values are used as the basis of comparison then changing the transport time from 55 to 80 minutes will increase the average KK-index value by 0.23 units, while the percentage of pigs with an unacceptable KK-index will only fall from 12 to 10% because of the correction for higher than normal pH_2-values which is built into the calculation.

If all pigs showed the same improvement in meat quality with increasing transport time, then the improvement could be corrected for statistically. If however, pigs vary in their reaction to increasing transport then it will not be possible to apply a correction. The results of this experiment show that the latter probably applies and moreover, that some of the variation in meat quality will be lost by increasing transport time. In addition, a greater percentage of the pigs will have an unacceptable KK-index as a result of higher than normal pH_2-values, when transport is increased to 80 minutes, and experience has shown that higher than normal pH_2-values can be caused by other factors than genetic pre-disposition for meat quality, e.g. fighting. The longer the pre-slaughter treatment, the greater will be the risk of environmental factors causing higher than normal pH_2-values.

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All in all it can be concluded that for pig breeding work the reliability of meat quality values will be best with the shortest possible pre-slaughter treatment. An increase in transport time from the present 40 minutes to 80 minutes cannot therefore be recommended.

References:

Barton, Patricia A. (1974) A standardised procedure for the pre-slaughter treatment of pigs to be tested for meat quality. 20th European Meeting of Meat Research Workers, September 15-20th, Dublin, Ireland,

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