

Effect of intramuscular fat level on eating quality of pig meat

Bejerholm, C. and Barton-Gade, P.
Danish Meat Research Institute, Maglegårdsvej 2, DK-4000 Roskilde, Denmark

Introduction

Intramuscular fat has become increasing interest in relation to eating quality in pork. Various studies have shown conflicting results. Some experiments have shown no effect (Rhodes, 1970; Howard et al, 1976 and Wood et al, 1981) while others have shown that intramuscular fat is very important for eating quality (Barton-Gade and Bejerholm, 1985; Batchelor and Dawson, 1960 and Cromwell et al, 1978). Danish experiments have consistently shown that a certain amount of intramuscular fat i.e. about 2% is necessary for good taste characteristics, but that excessive amounts such as 3-4% on average do not lead to any further great improvement in tenderness. The aim of this work is to further investigate the effect of intramuscular fat level, particularly the effect of low to moderate levels, on eating quality of normal and PSE-pork.

Materials and methods

The preliminary selection was based on automatic probe measurements (Barton-Gade and Olsen, 1984) in order to select a material with an expected wide variation in water holding capacity (WHC) and % intramuscular fat. The criteria for the final selection were analyses of WHC, intramuscular fat content and ultimate pH₂ in the longissimus dorsi muscles. Samples were taken from the muscle portions measured, trimmed of external fat and minced twice for the estimation of WHC (soluble sarcoplasmic and myofibrillar proteins) and intramuscular fat (SBR-method Nordisk Metodik-Komit  for levnedsmidler, 1974) and ultimate pH₂-value (radiometer pHM 64 with combination electrode GK 2401 C).

The final experimental material consisted of 198 normal pork loins (WHC>0.150) and 34 PSE pork loins (WHC≤0.150) divided into groups as shown below :

% intramuscular fat	Number of pork loins with	
	WHC≤0.150	WHC>0.150
< 1.00	3	14
1.00 - 1.49	12	74
1.50 - 1.99	10	36
2.00 - 2.49	7	29
2.50 - 2.99	-	12
≥ 3.00	2	33

Intramuscular fat content ranged from 0.70 to 6.78% and ultimate pH₂ values from 5.1 to 6.1.

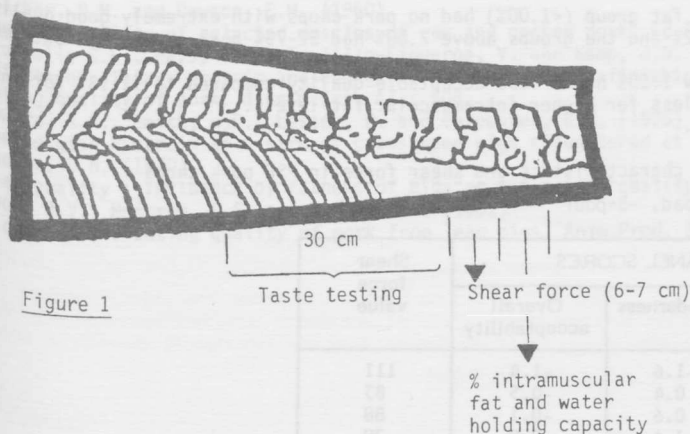


Figure 1

Loins about 30 cm were cut from the rib end of longissimus dorsi, boned out and defatted to about 5-10 mm fat thickness. Then they were divided into two cuts for shear force value and for taste testing (Figure 1). Both cuts were vacuumpacked, aged at 2°C to 7 days after slaughter and then frozen below -20°C until required. The samples for shear force were then thawed at 5°C, cooked to a final centre temperature of 72°C, cooled and then sheared once to 80% penetration with a Volodkewich shear attachment on a Karl Frank Testing Instrument. After thawing at 4-5°C the samples for taste testing were sliced into chops with a thickness of 2.0 cm and heated 8 minutes without additional fat on a griddle plate to a centre temperature of about 65°C, i.e. not well done, but with a light pink colour. The taste testing was carried out by a 9-member panel. The samples were scored for colour (fried), flavour, tenderness, juiciness and overall acceptability on an 11-point symmetric, hedonic scale where +5= ideal, 0 = neither good nor bad and -5=poor.

Results

The results for pork with a good WHC are shown in Table 1.

Table 1 : Effect of intramuscular fat on taste characteristics and shear force in normal pork chops

Scoring scale : +5=ideal, 0=neither good nor bad, -5=poor
Shear force : Values above 100=tough meat

% intramuscular fat		TASTE PANEL SCORES			Shear force value
group	average	Flavour	Tenderness	Overall acceptability	
<1.00	0.86	0.8	0.6	0.0	100
1.00-1.49	1.24	1.6	1.7	1.2	86
1.50-1.99	1.73	1.7	1.9	1.4	78
2.00-2.49	2.37	1.9	2.2	1.9	79
2.50-2.99	2.76	2.5	2.7	2.3	76
≥3.00	3.94	2.3	2.7	2.3	69

Increasing intramuscular fat content improved eating quality and fat levels above 2.0% on average gave tender meat, whereas flavour improved up to 2.5%. Moreover, a comparison of the lowest intramuscular fat group (<1.00%) with the moderate groups (1.00-1.99%) clearly showed the poorest eating quality in the groups with low intramuscular fat content. The results were confirmed by the shear force values showing that pork with intramuscular fat below 1.00% had the highest shear force value, on average 100 corresponding to slightly tough meat. Table 2 shows the results of each intramuscular fat group in relation to percent grouping of pork chops in less acceptable, acceptable and extremely good quality.

Table 2 : Grouping of normal pork chops in relation to intramuscular fat levels and overall acceptability scores
Scores <0.0=less acceptable, scores 0.0-1.9=acceptable and scores ≥2.0= extremely good

% intramuscular fat group	Number of loins	Overall acceptability mean score	% pork chops with		
			less acceptable quality	acceptable quality	extremely good quality
<1.00	14	0.0	29	71	0
1.00-1.49	74	1.2	13	57	30
1.50-1.99	36	1.4	11	47	42
2.00-2.49	29	1.9	3	45	52
2.50-2.99	12	2.3	0	25	75
≥3.00	33	2.3	0	36	64

The results showed that the low intramuscular fat group (<1.00%) had no pork chops with extremely good quality while the moderate groups (1.00-1.99%) had 30-42% and the groups above 2.00% had 52-75% pork chops with extremely good quality.

29% of pork chops with intramuscular fat below 1.00% had a less acceptable quality compared to 11-13% for intramuscular fat between 1.00 and 1.99 and 3% or less for higher intramuscular fat levels. The results for PSE-pork are shown in Table 3.

Table 3 : Effect of intramuscular fat on taste characteristics and shear force in PSE pork chops

Scoring scale : +5=ideal, 0=neither good nor bad, -5=poor

Shear force : Values above 100=tough meat

% intramuscular fat		TASTE PANEL SCORES			Shear force value
group	average	Flavour	Tenderness	Overall acceptability	
<1.00	0.85	1.1	-1.6	-1.4	111
1.00-1.49	1.23	0.7	0.4	-0.5	83
1.50-1.99	1.64	1.0	0.6	-0.1	88
2.00-2.49	2.09	1.5	1.4	0.9	79
2.50-2.99	-	-	-	-	-
≥3.00	3.72	2.9	3.7	2.3	61

Intramuscular fat also had an improving effect for PSE-pork especially in tenderness, although the scoring level was lower than for normal pork. The results indicated that fat levels above 2.0% could to some degree neutralize the effect of a poor water holding capacity. As found for normal pork there was a clear improvement in tenderness when comparing the lowest intramuscular fat group (<1.00%) with the moderate groups (1.00-1.99%). Danish experiments have normally shown no correlation between tenderness and shear force values in PSE-pork, but in the present experiment a tendency was found for shear force values to decrease with increasing tenderness scorings. The percent grouping of PSE-pork in less acceptable, acceptable and extremely good quality is shown in Table 4.

Table 4 : Percent grouping of PSE-pork chops in relation to intramuscular fat levels and overall acceptability scores

Scores <0.0=less acceptable, scores 0.0-1.9=acceptable and scores ≥2.0=extremely good

% intramuscular fat group	Number of loins	Overall acceptability mean score	% pork chops with		
			less acceptable quality	acceptable quality	extremely good quality
<1.00	3	-1.4	100	-	-
1.00-1.49	12	-0.5	50	50	-
1.50-1.99	10	-0.1	50	50	-
2.00-2.49	7	0.9	29	57	14
2.50-2.99	0	-	-	-	-
>3.00	2	2.3	-	-	100

The percent of pork chops with less acceptable quality was in general higher than for normal pork chops. All the PSE-pork loins in the low intramuscular fat group (<1.00) had a less acceptable quality, while the moderate group (1.00-1.99) had 50% with less acceptable quality and 50% with acceptable quality. For the group with 2.00-2.49% intramuscular fat the percentage of chops with an unacceptable quality fell and the two samples with fat above 3.00% both had an extremely good quality.

Discussion and conclusion

In general the results of this experiment have confirmed that increasing intramuscular fat improves eating quality in normal pork ant to some degree also in PSE-pork, even within the groups having low to moderate intramuscular fat i.e. below 2.0%.

The results are typical for Danish work and showed that a certain amount of intramuscular fat - i.e. about 2.0% - is necessary for good taste characteristics but that excessive amounts, such as the group with 3.0% on average do not lead to any further major improvement. This is perhaps fortunate because there is a direct conflict between intramuscular fat levels and palatability. Many consumers will reject meat with a high intramuscular fat content from a nutritional point of view, even though this will almost certainly be of a good eating quality. The results also confirm that PSE-meat generally has an unacceptable meat quality and that such meat is only satisfactory at high fat levels.

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