INTRAMUSCULAR FAT AND CONSUMERS' PERCEPTION OF PORK

Pieter Walstra[1], Garmt B. Dijksterhuis[1*], Jan W.M. Merks[2] en Egbert Kanis[3]

[1]Institute for Animal Science and Health (ID-Lelystad), P.O. Box 65, 8200 AB Lelystad, The Netherlands
[2]IPG, Institute for Pig Genetics BV, P.O. Box 43, 6640 AA Beuningen, The Netherlands
[3]Wageningen University, Departement of Animal Sciences, P.O. Box 338, 6700 AH Wageningen, The Netherlands
* Present address: Royal Veterinary and Agricultural University (Sensory Science Section), Rolighedsvej 30, DK-1958, Copenhagen, Denmark

Key words: intramuscular fat, consumer perception, genotype, feeding level, sex, slaughter weight

Background

As part of a larger project with the general aim to relate feed intake to fat and protein deposition of growing pigs, also sensory characteristics of pork were studied. Feed intake should be such that pigs realise their maximum protein accretion. However, does this also favour eating quality of meat? Selection for maximum protein deposition, therefore, should consider effects on intramuscular fat content (IMF%) and with that on eating quality. IMF% is often related to flavour and tenderness of meat (a.o. Lawrie, 1985; Affentranger, 1994). Fat percentage of the whole carcass increases with weight at slaughter and a higher feeding level and is higher in castrates than in sows and boars (Walstra, 1980; and many others). IMF% in pork varies much; e.g. De Vries et al. (1994) found 1.33 ± 0.52, in Yorkshire lines of seven Dutch breeding companies. They also calculated genetic correlations for IMF being negative with lean meat percentage (r_g = -0.37) and positive with feed intake (r_g = 0.22). Furthermore, there are marked differences between breeds, e.g. Duroc often yields a higher IMF%. Selection for high lean meat percentage has a decreasing effect on IMF%. However, because of moderate heritabilities (h^2 = 0.41, De Vries et al., 1994; h^2 = 0.49-0.58, Schwörer et al., 1995) a decay in IMF% may be averted. Selection for IMF% in Switzerland since 1985 reversed into a slight increase of IMF% (Schwörer et al., 1995), indeed.

Objective

This study gives a further quantification of the differences in sensory characteristics of pork related to IMF content.

Methods

Sensory characteristics were matched with the experimental factors genotype, sex, feeding level and slaughter weight. The total project comprised 5 genotypes, 3 sexes (boars, castrates and gilts), 3 weight trajectories (25 – 65 kg, 65 – 95 kg (P2), 95 – 125 kg (P3)) and 3 feeding levels (*ad libitum* (AL), about 75% of *ad lib.*(B1) and about 60% of *ad lib.*(B2)). Not all of these conditions were relevant for the consumer evaluation. Meat samples presented to a consumer panel were from 2 types of commercial crossbred pigs (genotype A and B), 2 sexes (castrates and gilts), 2 feeding levels (AL and B1) and 2 different weights at slaughter (P2 and P3).

A cross-section of 5 cm out of the middle of the loin muscle at the 3rd lumbar vertebra was used for assessment of IMF% according to the Soxhlet method. At the day of slaughter loins were deep-frozen at -20 °C until panel evaluation.

IMF content was chosen as the main experimental factor. Samples were allocated to 4 IMF classes: ≤ 0.50, 0.51 – 1.00, 1.01 – 1.50 and ≥ 1.50% and equally divided over genotype and feeding level. So, there were 4 IMF classes x 2 genotypes x 2 feeding levels = 16 conditions. The samples were taken from right and left loins both from lumbar and thoracic parts from 86 available carcasses. The consumer panel of 256 people was selected from a larger pool that regularly evaluated all kinds of products. Therefore, panellists were able to judge for intensity aspects as well. Within days (4 days of testing and 4 sessions per day) 64 consumers evaluated all 16 conditions. Another 64 consumers were called for the second day, etc. IMF classes changed between sessions within days, and were balanced between days. Samples were 1.5 cm thick without subcutaneous fat, only salted a little. The consumers judged the grilled samples on 5 appreciation and 13 intensity aspects all on a line scale anchored at 10 and 90 mm, only the ac-ceptance aspect 'total judgement' was on a scale from 1 – 10. The consumers were 50% women and 50% men, while there were 3 age groups: 20 – 35, 36 – 50 and 51 - 60 years old. Furthermore, 60% of the respondents ate pork 4 to 5 times a week, 17% 2 to 3 times and 23% 6 to 7 times.

In addition to IMF class and the pig characteristics (genotype, feeding level, sex and weight), various consumer characteristics (gender, age category and consumption pattern) were considered as well in various models:

1a) IMF class
1b) IMF class + consumer characteristics
1c) consumer characteristics + IMF class*genotype
2) consumer characteristics + pig characteristics
3) IMF class + consumer characteristics + pig characteristics

The analyses of variance were carried out for both the acceptance and the intensity aspects. Furthermore, also a PCA (principal component analysis) with varimax rotation was applied, only for the intensity data.

Results and discussion

The average IMF% in the loin was 0.99 ± 0.67, with median, minimum and maximum values of 0.87, 0.13 and 4.78 respectively. Minimum values were low, meaning that there are pigs with hardly any fat in the muscles. There were clear differences in IMF% between experimental factors, although only effect of genotype and weight were significant. IMF% was found to be positively associated with the rate of body fatness of the respective condition: IMF content was 0.40% higher in genotype B than in A, 0.20% higher in castrates than in gilts, 0.30% higher at P3 than at P2 and 0.25% higher at AL feeding level than at B1. The mean IMF% was lower than in earlier experiments in the Netherlands (e.g. De Vries et al., 1994), mainly as a consequence of some unusual experimental conditions chosen (e.g. 95 kg and restricted feeding). Differences in IMF% are to be expected: Schwörer et al. (1989), in a comprehensive survey, gave 0.92 to 4.19% in various Landrace and Yorkshire breeds in Europe; our results were in line with this. A larger variation was given for Duroc with a range in IMF% from 2.08 to 7.88%.

The results on the consumer judgements for the acceptance aspects, over all experimental factors, are given in Table 1. A significant effect of IMF class was found for taste, mouthfeel and total judgement; appearance and odour were not discriminative. The IMF class with ≤ 0.5% was distinct from the other classes. With regard to the 13 intensity aspects there were only significant differences between IMF classes for real meat flavour, tenderness, juiciness and firmness. An increased IMF% resulted in more tender, more juicy and less firm meat and in more real pork flavour. The profile scheme for the various intensity aspects is given in Figure 1, where the differences for tenderness and juiciness clearly can be seen. PCA showed that the intensity aspects could be condensed to three factors: flavour (odour intensity, taste intensity, a full, spicy and fresh taste, juiciness), texture (firmness, chewiness) and real taste/tenderness (no off-flavour, no fatty taste, real taste, tenderness, stringiness). The last two factors were significantly related to IMF%. The scores as such for tenderness and juiciness were not high, which could be expected, because the meat was prepared without spices, only a little salted, while all outer fat was trimmed off.

The analysis with model 1c showed a significant interaction between IMF class and genotype for flavour, mouthfeel and total judgement. A low IMF% had a negative influence on the appreciation of the quality of genotype A, while no differences in were found in the appreciation between the higher percentages of IMF. For genotype B there was hardly any effect of IMF. Comparison of models 2 and 3 learned that taste and mouthfeel were influenced especially by genotype and feeding level. Meat was more tender at

Table 1. Mean judgement per IMF class for the acceptance aspects (in bold significant differences, model 1a; $P < 0.05$).

IMF% class	Appearance	Odour	Flavour	Mouthfeel	Total judgement
≤ 0.50	61	61	**50**	**47**	**5.7**
0.51 – 1.00	63	63	**56**	**53**	**6.2**
1.01 – 1.50	64	64	**55**	**53**	**6.3**
≥ 1.51	64	62	**56**	**55**	**6.4**

feeding level AL, in castrates and at P3; more juicy meat was found in genotype A, in castrates and at P3; castrates had more stringy meat; at feeding level B1 meat was firmer, while the chewiness was lower for genotype B. Significant effects for sex and weight were found without correction for IMF. This was also reported by Göransson et al. (1992), be it with an analytical panel and not a consumer panel. The effects of sex and weight vanished when IMF classes were included in the model and were appararently due to differences in IMF%.

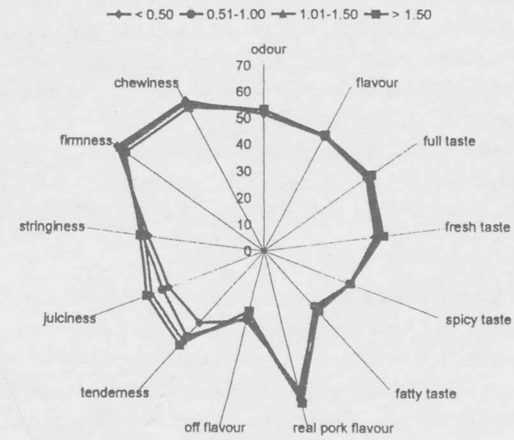

Fig. 1. The profile scheme for the various intensity aspects in the four IMF classes.

Meat samples were more appreciated by men than by women (6.3 vs 6.0) and also more by more frequent eaters of pork. Age groups and samples from right and loin did not differ. Samples from the lumbar part of the muscle did not differ from those of the thoracic part. Göransson et al. (1992) did find differences within the loin muscle, but the lumbar part was not involved in their study.

In the literature, the recommended IMF% is rather variable, from 0.8 to 3.0%. Moreover, these are based on *analytical* panels. In the present study, with consumers, 0.5% IMF clearly was too low. Marbling becomes visible at 2.0% IMF (Hoving-Bolink et al., 1994) and this is not well appreciated by consumers (Steenkamp and Van Trijp, 1988). Thus, the optimum level for IMF should be 1.5 to 2.0%. Too low percentages would occur, because of natural variation, when the lower limit is set further downwards. The present trial indicates that genotype, feeding level, sex and end weight are means to control IMF content. Combinations of, e.g., more Duroc blood, a high feeding level and a higher slaughter weight can avoid a too low IMF%. The moderate heritabilities for IMF indicate that there are sufficient possibilities within breeding programmes to increase IMF%. Furthermore, the discovery of a marker-gene (Gerbens et al., 1999), which is responsible for variation in IMF, opens perspectives to combine thin back fat with a higher IMF content.

Conclusions

- Differences in sensory attributes between samples of pork are found. The consumer panel members especially distinguish between attributes which have to do with mouthfeel (the texture properties tenderness, stringiness and the like) and with flavour.
- Differences in sensory attributes are partly due to differences in the production factors genotype, feeding level, sex and end weight.
- The influence of these production factors acts, especially for sex and slaughter weight, through the influence on IMF%. Besides, genotype and feeding level have also an influence in addition to IMF%.
- Meat with a low IMF% (especially ≤ 0,5%) is less appreciated by the consumer, but this is dependent on the genotype involved.
- It will be hard to produce pork that will be appreciated by all or many consumers, because even within a trained analytical panel, which was also part of the total project, meat samples of the same animal were judged differently.

References

Affentranger, P., 1994. Dissertation, ETH, Zürich, 119pp.
Gerbens, F., A.J.M. van Erp, F.L. Harders, F.J. Verburg, T.H.E. Meuwissen, J.H. Veerkamp and M.F.W. te Pas, 1999. J. Anim. Sci. 77:846-852.
Göransson, Å., G. von Seth and E. Tornberg, 1992. Proc. 38th ICoMST, Clermont Ferrand, France, Vol. 2, 245-248.
Hoving-Bolink, A.H., G. Eikelenboom, G. Vonder en A.W. de Vries, 1994. IVO-Rapport B-372, 27pp.
Lawrie, R.A., 1985. Meat Science, Fourth Edition, Pergamom Press, Oxford etc., 247pp.
Schwörer, D., P. Morel and A. Rebsamen, 1989. 40th Annual Meeting EAAP, Dublin, Ireland, Paper PG 3.2, 12pp.
Schwörer, D., A. Rebsamen and D. Lorenz, 1995. Proc. 2nd Dummerstorf Muscle-workshop (K. Ender, ed.), Dummerstorf, 116-124.
Steenkamp, J.E.B.M. en J.C.M. van Trijp, 1988. PVV-Rapport no. 29, Rijswijk, Nederland, 306pp.
Vries, A.G. de, P.G. van der Wal, T. Long, G. Eikelenboom and J.W.M. Merks,1994. Livest. Prod. Sci., 40:277-289.
Walstra, P., 1980. PhD Thesis, Meded. Landbouwhogeschool 80-4, 206pp.