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Consumer issues

SENSORY STUDY OF PIG MEAT IN FIVE NORDIC COUNTRIES USING THE SAME METHODOLOGY

Agerhem, H.[1]; Pajari, M.[2]; Blümlein, L.[3]; Valdimarsdóttir, T.[4]; Claudi-Magnussen, C.[5]

[1)] Swedish Meat Research Institute, Sweden; [2)] Finnish Meat Research Institute, Finland; [3)] Norges Slakteri Laboratorium, Norway; [4)] Agricultural Research Institute, Iceland; [5)] Danish Meat Research Institute , Denmark

Abstract

Interlaboratory sensory study of pork (*M. longissimus dorsi*) was conducted in five Nordic countries. The standardised methodology worked out was based on an inventory of descriptions provided by the members of the project. The methodology included selection and training of 8 assessors in each panel. 40 pigs were collected in all five participating countries, 8 in each country. The participating panels were supplied with coded samples from all forty pigs for sensory evaluation in two replicates. Each panel used the same list of six descriptors and the same experimental design.

The interrelationships of attributes between institutes, with few exceptions, were significantly correlated for hardness and juiciness, but flavour attributes were poorly interrelated between the panels. The correlation between the second and the first replicate for all panels and attributes was good (r=0.7-0.9) and highly significant. The repeatability of the separate panels was, however, not always as good. The difference between the panels was mainly attributed to the use of scales.

Introduction

Comparisons of sensory profiling of pig meat performed by different laboratories in varying countries are seldom found in literature. However, such comparisons are very important for the meat industry both in research, quality control and product development. Dransfield *et al* (1982) reported a study using beef meat. Loin steaks were assessed at five institutes and the interrelationships between institutes were examined. In the reported study each institute used its own methodology for sample preparation and sensory assessment. Only the attribute tenderness was significantly interrelated between institutes.

The aim of this interlaboratory study was to recognise, by an inventory, if the members of this project had different approaches to descriptive profiling of pig meat and if there is a need to standardise the methodology. Moreover, it was of interest to establish, whether trained panels in the five Nordic laboratories rated the sample differences in the same way using the same standard methodology.

Material and Methods

Trained panels from five laboratories DMRI (Denmark), FMRI (Finland), NSL (Norway), ARI (Iceland) and SMRI (Sweden) participated in the study. The standardised methodology worked out was based on an inventory of descriptions of pig meat evaluation provided by the members of the project.

40 pigs were collected in all participating countries, 8 in each country. The *M. longissimus dorsi* with bones and fat, was cut out and stored at +4 °C for three days. The bones and the remaining part of subcutaneous fat was then trimmed off in a standardised way so that 5 mm was left on the cutlet. The loins were cut into 2 cm slices, vacuum packed in plastic bags and individually deep-frozen at -40°C and kept at -20°C until the analysis. Each laboratory were then supplied with coded frozen, samples from all fourty pigs for sensory evaluation in two replicates. The samples were thawed in its own plastic bags the day before sensory evaluation first at +4 °C overnight (approx. 16.5 hours), then for 1 hour at room temperature and cooked in 70°C-hot water for 30 minutes to an internal temperature of 68°C. Two pieces were cut out of each cutlet and the edges taken away. The samples were presented to the sensory panels immediately on removal from the water-bath. The methodology included selection (ISO-8586-1-1993) and training of 8 assessors in each country. Training consisted of two parts: qualitatively, by learning the attributes and quantitatively, by learning to rate the perceived intensity of the attributes consistently on a line scale. The training took place using real meat samples from each country's own material. Each laboratory decided separately whether or not the assessors are trained sufficiently. To check the repeatability of the separate assessors a method based on a graphical technique was recommended, i.e. plots of an assessor ability to detect differences vs. his/her repeatability. The method includes Analysis of Variance to produce p-values and mean square of error for each assessor and each attribute separately (Lea. *et al.*, 1995).

It was decided that two replicate judgements were to be made on each loin by each assessor in the same experimental design followed by all laboratories. All five panels used the same list of six descriptors: hardness, juiciness, tenderness, meat taste, acidity and off-flavour. The list had been generated together by all participants and sent, together with definitions, to each participant for translation into their own language. The attributes were rated on an unstructured line-scale. The scale was anchored at the extremes with the labels none (0) and very strong (100).

Statistical analysis

Mixed Model Analysis of Variance was used for the data analyses. The model used included the random effect of animal and assessor, and the fixed effects of country of production and laboratory. ANOVA calculations were performed using SAS, 1995. Multivariate analyses, PCA and PLS2 were performed using the Unscrambler 6.1, 1996.

Results and discussion

The ANOVA gave significant effects of country of production, animal, laboratory and assessor ($p<0.0001$) on all descriptors: hardness, juiciness, tenderness, meat taste, acidity and off-flavour. The interaction between laboratory and country of production was also significant. Only for one descriptor, acidity, there was no interaction between laboratory and country of production. To examine the effects of different factors, the results of Mixed Model Analysis of Variance are summarised in form of F-Ratios in Table 1.

Table 1. The results, expressed as F-Ratios, of Mixed Model Analysis of Variance, n=3200.

Factor	Degr of Freedom	Hardness	Tenderness	Juiciness	Meat taste	Acidity	Off-flavour
Country of production	4	106,7	65	43	46	30	57
Laboratory	4	157,7	648	154	144	926	386
Assessors{Lab}	36	32,3	43	24	75	38	39
Assessors* Country of Prod {Lab}	160	1,5	12	12	4	2	13
Animal{ Country of Prod }	35	24,5	6	9	3	3	4

Examining the F-ratios in Table 1, it is clear that laboratory had larger effect than country of production on the results. Differences within the laboratories, i.e. assessors performances, were not always as high. Using F-ratios as the criteria it is clear that there were large differences between the panels in the interpretation of the varying sensory attributes. Examining the overall means, Figure 1, for hardness and tenderness judged by the five laboratories for meat produced in country 2, and acidity for meat produced in country 5, it was apparent that the differences between the panels were mainly attributed to the use of scales. On average NSL tends to score lower for tenderness, as an example, and DMRI lower for hardness and acidity then the other laboratories. In generally, however, almost all samples were ranked by the laboratories in the

same order. The correlation between the second and the first replicate for all panels and attributes was also good (r=0.7-0.9) and highly significant. The repeatability of the separate panels however, differed a lot and was not always as good (r=0.2-0.9). Texture attributes were repeated better than flavour.

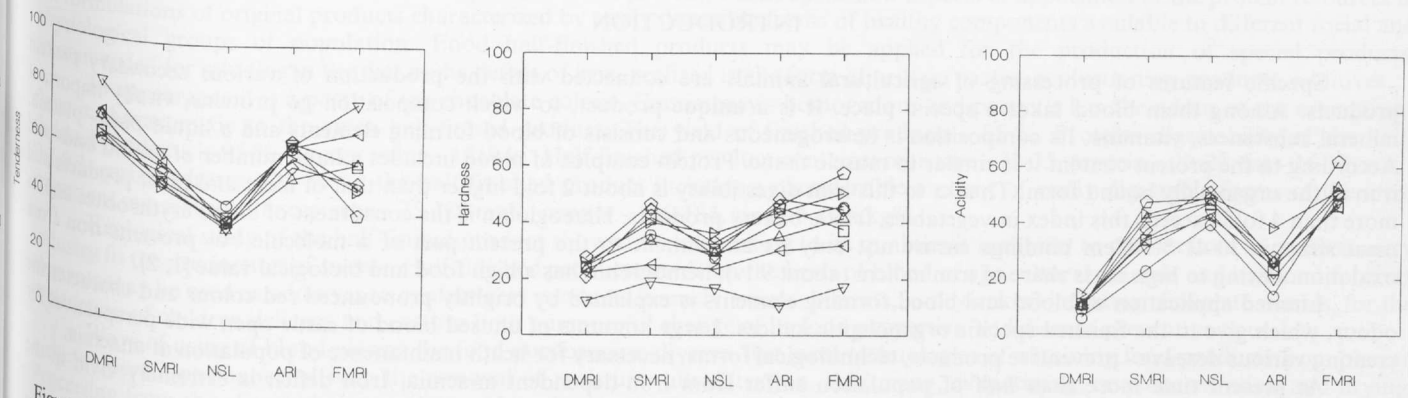

Figure 1. Mean scores for tenderness, hardness (samples from country of production 2) and acidity (samples from country of production 5) judged by the five laboratories.

The interrelationships of attributes (Pearson correlation coefficients) between institutes, with few exceptions, were significantly correlated for hardness and juiciness (highest r=0.73), whereas flavour attributes were poorly interrelated (highest r=0.59).
One objective of the study was to establish, whether it is possible to predict a panels sensory results from the results of another panel. The PLS2 analysis can be useful for prediction, if the y-variables are known to be strongly interrelated with each other, like sensory data usually are. PLS2 performs a simultaneous PCA in both x- and y-matrices and these are then correlated to each other by regression. The advantage of PLS2 is that it can give an optimal prediction of the sensory data by using all the attributes. Figure 2 shows, as an example, ARI's ability to predict NSL's, SMRI's and DMRI's results.

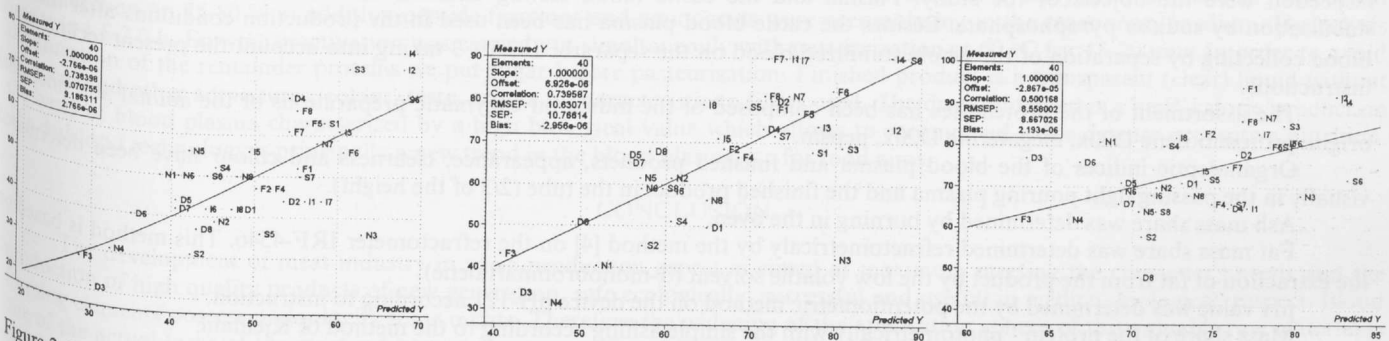

Figure 2. PLS2: X-var: ARI, Y-var: NSL, r=0.74 X-var: ARI, Y-var: SMRI, r=0.74 X-var: ARI, Y-var: DMRI, r=0.58

The ability of prediction were different for the different laboratories. The ability of prediction depends on the sample position in the multivariate space in the PCA matrices of the both laboratories, i.e. x and y in PLS2. NSL's data (r=0.35), SMRI's data (r=0.23) and FMRI's data (r=0.16) had the lowest ability of prediction from DMRI's results. DMRI's results had very low ability to predict FMRI's data (r=0.08). The best ability of prediction of ARI's results had NSL's data (r=0.74), SMRI's data (r=0.69) and DMRI's results (r=0.72), prediction of NSL's results with FMRI's data (r=0.72) and prediction of SMRI's and NSL's results by ARI's data (r=0.74 for both).

Concluding remarks

The difference between the panels was mainly attributed to the use of scales, which shows that there is a need to standardise training procedures in a more exact way and that common standards, stable in time, should be used for training. No progress will be made towards understanding consumer's expectations and reactions concerning sensory characteristics of pig meat in different countries unless some degree of agreement between laboratories can be reached concerning pig meat assessment of both texture and flavour.

References

Claudi-Magnussen, C., Agerhem, H., Pajari, M., Valdimarsdottir, T., Blümlein, L. (1997). Projekt nr. P 93135 "Sensorisk kalibrering". Afsluttende rapport.

Dransfield, E., Rhodes, D.N., Nute, G.R., Roberts, T.A., Boccard, R., Touraille, C., Butcher, L., Hood, D.E., Joseph, R.L., Schon, I., Casteels, M., Cosentino, E., Tinbergen, B.J. (1982). Meat Science, 6, 163-184.

ISO standard 8586-1-1993 Sensory Analysis - General guidance for the selection, training and monitoring of assessors.

Lea, P., Rødbotten, M., Næs, T. (1995). Measuring validity in sensory analysis. Food Quality and Preference. In press.