THE EFFECTS OF RN GENOTYPE AND TUMBLING ON SENSORY AND TECHNOLOGICAL MEAT QUALITY OF CURED-SMOKED LOINS

Hullberg A.[1], Lundström K.[1], Virhammar K.[2]
[1] Dept. of Food Science, Swedish University of Agricultural Sciences, P.O. Box 7051, SE-750 07 Uppsala, Sweden
[2] Dept. of Domestic Sciences, Uppsala University, Dag Hammarskjölds väg 21, SE-752 37 Uppsala, Sweden

Background

Meat quality is affected both by genetic and environmental factors. A major gene known as the RN^- gene, present only in pigs of Hampshire breed or crossbreeds with Hampshire, has a great impact on meat quality as it gives rise to an increased glycogen content and low ultimate pH in glycolytic muscles (Fernandez et al., 1992). As a result, the structure is affected and the meat has poorer water-holding capacity (Lundström et al., 1996; Enfält et al., 1997). Sensory perception is also affected by RN genotype and fresh meat with the RN^- allele is often scored as more tender, juicy and acid than meat without the allele (Johansson et al., 1999; Jonsäll et al., 2000). Processed products from meat of different RN genotypes show similar sensory profiles, but this has not been studied so frequently (Johansson et al., 1998; Eber & Müller, 1999; Josell, 1999).

The majority of the processed pig meat products on the market are cured and cooked, but they are processed under different processing conditions, all of which influence meat quality. Tumbling is known to enhance meat quality in several ways. It increases the water-holding capacity, and also distributes the brine more evenly in the meat (Krause et al., 1978). Despite the advantages, not all processed meat is tumbled and delicious non-tumbled products are found on the market. The effects of tumbling on the sensory perception of meat, except for tenderness, are rarely studied and to our knowledge the combined effect of tumbling and RN genotype, considering eating quality, has not been investigated.

Objectives

The aim of this investigation was to study the effects of RN genotype and tumbling on the sensory perception and technological quality of cured-smoked loins.

Methods

The material consisted of loins from 32 randomly selected crossbred female pigs [Hampshire x (Swedish Landrace x Swedish Yorkshire)] raised commercially and slaughtered at an average live weight of 115 kg. The pigs were stunned with CO_2 and the *M. longissimus dorsi* (LD) from both sides were selected 24 h post mortem. Pigs were genotyped (rn^+rn^+ or RN^-rn^+) according to Milan et al. (2000). Loins were processed in an experimental processing plant and 16% nitrite saline was needle injected to a quantity of 16-17% of green weight. Right side loins were tumbled for 4 hours, each RN genotype separately. Left side loins, which were not tumbled, were held in plastic trays during the tumbling of right side loins. All loins were then smoked-heated to an internal temperature of 68°C for 3.5 hours before being cooled to +4°C.

Technological measurements were performed on processed loins. Salt and water content was measured on slices trimmed from fat and crust. Surface meat colour was determined with a colorimeter (Minolta Chroma Meter CR-300, Osaka, Japan) using the L*a*b* colour space. Instrumental tenderness was measured as Warner-Bratzler shear force with a Texture Analyser HD100 (Stable Micro Systems Ltd, Godalming, UK) as described by Honikel (1998). Processing yield was calculated as the ratio between final weight and green weight x 100.

A descriptive sensory test was carried out by a selected and trained sensory panel consisting of six members. Samples were tested in duplicates and served as two 4 mm thick room tempered slices. Only the centre of the slices was scored as the outer crust and fat layer had been removed. The samples were assessed for tenderness, juiciness, acidity, pattyness, crumbliness, stringiness, taste intensity, saltiness, degree of pores and evenness in surface colour on a continuous scale from 1 to 100 with higher values indicating higher intensity of the attribute. Also, consumer test was performed. Room tempered slices of cured-smoked loins from the four different treatment groups were ranked for degree of liking. The test included 145 untrained test persons of different age and sex.

Data were analysed using the procedure MIXED (SAS, version 6.12). The models included the fixed effects of RN genotype and tumbling and the random effect of assessor. Two-way interactions and covariate (green weight of loins) were included when significant ($p<0.05$). The consumer test was statistically evaluated with Friedman test (Piggott, 1986).

Results and discussion

RN^- carriers (RN^-rn^+) were scored as more acid and having more intense taste than non-carriers (rn^+rn^+) (Figure 1). They were also saltier than non-carriers, which could not be confirmed statistically by the salt concentration (Table 1). There was a tendency to higher juiciness in RN^- carriers, which is in accordance with the higher juiciness found in RN^- loins by Johansson et al. (1998) and Josell (1999). RN^- carriers tended to be less even in surface colour, but the homogeneity of surface appearance regarding RN genotype varies between studies. The findings of Eber and Müller (1999) agree with the present study, Josell (1999) found no differences, while Johansson et al. (1998) found a more even surface appearance in RN^-rn^+ loins. There were no significant differences in sensory scores for the attributes tenderness, pattyness, crumbliness, stringiness and degree of holes between RN genotypes. The lack of differences in tenderness was confirmed by the shear force values. The sensory results for tenderness are in agreement with Lundström et al. (1998), but there are studies on fresh meat describing both higher tenderness (Johansson et al., 1999; Jonsäll et al., 2000) and lower tenderness (Le Roy et al., 2000) for RN^- carriers.

Tumbling increased tenderness and juiciness in the loins as shown earlier in cured goat hams (Dzudie & Okubanjo, 1999), and tended to give a reduced acid taste (Figure 1). Surface colour was more even after tumbling and the degree of holes was noticeably reduced by tumbling (Hullberg & Ballerini, 2002). Neither pattyness, crumbliness, stringiness, nor taste intensity or saltiness were affected by tumbling.

Even though the sensory and technological tenderness results lead to the same conclusion the correlations between the methods were mediocre. The highest correlation found was between Warner-Bratzler peak force and initial tenderness for non-tumbled loins ($r=-0.3$; $p<0.09$).

Process yield was, as expected, lower for RN^- carriers than for non-carriers (4.4 percentage points). Tumbling significantly increased the process yield by 2.2 percentage points. Tumbled loins from non-carriers contained less salt than loins from the other treatments. No significant differences between treatment groups were found in the consumer test. Either there were no big differences between the cured-smoked loins tested, or it might have been too difficult for the consumers to rank this kind of product.

Conclusions

Both tumbling and RN genotype affected sensory and technological quality of cured-smoked loins, but tumbling had a more pronounced effect than the RN genotype. Tumbling resulted in a more tender and juicy product with a more even surface appearance. Cured-smoked loins from RN^- carriers were more acid and salty and had higher taste intensity than non-carriers. They also tended to be juicier and less homogeneous in surface appearance. Processing yield was decreased in the presence of the RN^- allele and increased by tumbling. The results indicate that the differences between RN genotypes can not be overcome by including tumbling in the process.

Pertinent literature

Dzudie, T. and Okubanjo, A. (1999) *Journal of Food Engineering* **42**, 103-107.
Eber, M. and Müller W. D. (1999) *Fleischwirtschaft International* **1**, 19-22.
Enfält, A.-C., Lundström, K., Hansson, I. et al. (1997) *Livestock production Science* **47**, 221-229.
Fernandez, X., Tornberg, E., Naveau, J. et al. (1992) *Journal of the Science of Food and Agriculture* **59**, 307-311.
Honikel, K. O. (1998) *Meat Science* **49**, 447-457.
Hullberg, A. and Ballerini, L. (2002) *Proc. 48th ICoMST,* Italy.
Johansson, L., Lundström, K., Jonsäll, A. et al. (1999) *Food Quality and Preference* **10**, 299-303.
Johansson, M., Josell, Å., Lundström, K. et al. (1998) *Proc. 44th ICoMST,* Spain, 916-917.
Jonsäll, A., Johansson, L., Lundström, K. et al. (2000) *Food Quality and Preference* **11**, 371-376.
Josell, Å. (1999) *Proc. 45th ICoMST*, 508-509.
Krause, R. J., Plimpton, R.F., Ockerman, H. W. et al. (1978) *Journal of Food Science* **43**, 190-192.
Le Roy, P., Elsen, J. M., Caritez, J. C. et al. (2000) *Genetics Selection Evolution* **32**, 165-186.
Lundström, K., Andersson, A. and Hansson, I. (1996) *Meat Science* **42**, 145-153.
Lundström, K., Enfält, A.-C., Tornberg, E. et al. (1998) *Meat Science* **48**, 115-124.
Milan, D., Jeon, J. T., Looft, C. et al. (2000) *Science* **288**, 1248-1251.
Piggott, J.R. (1986) *Statistical procedures in food research.* Elsevier Applied Science Publishers LTD, Essex.

Acknowledgements

The authors wish to thank Jonas Bjärstorp, Swedish Meats R&D, Kävlinge, for technical assistance and valuable help with the processing of the loins. We would also like to thank Dr Ingemar Hansson, Department of Food Science, Swedish University of Agricultural Sciences, Uppsala, for valuable assistance at the slaughterhouse and cutting of samples.

Table 1. Technological data of tumbled and non-tumbled cured-smoked loins of different RN genotype (least-squares means± standard error)

	rn^+rn^+ n=34	RN^-rn^+ n=30	SEM	*p*-value	Non-tumbled n=32	Tumbled n=32	*SEM*	*p*-value
Colour – L*	70.0	68.6	0.4	**0.011**	69.1	69.5	0.3	**0.025**
a*[a]	7.72	8.52	0.20	**0.009**	8.07	8.17	0.15	0.290
b*	5.54	5.96	0.07	**0.001**	5.74	5.76	0.06	0.740
Salt content, %[a]	3.06	3.18	0.05	0.123	3.18	3.05	0.05	0.057
Water content, %	73.7	73.6	0.2	0.576	73.3	74.0	0.2	**0.001**
Process yield, %	102.2	97.8	0.5	**0.001**	98.9	101.1	0.4	**0.001**
Shear force, N	18.5	18.6	0.4	0.932	20.1	17.0	0.3	**0.001**

[a] A significant interaction between RN genotype and tumbling conditions exist ($p<0.05$).

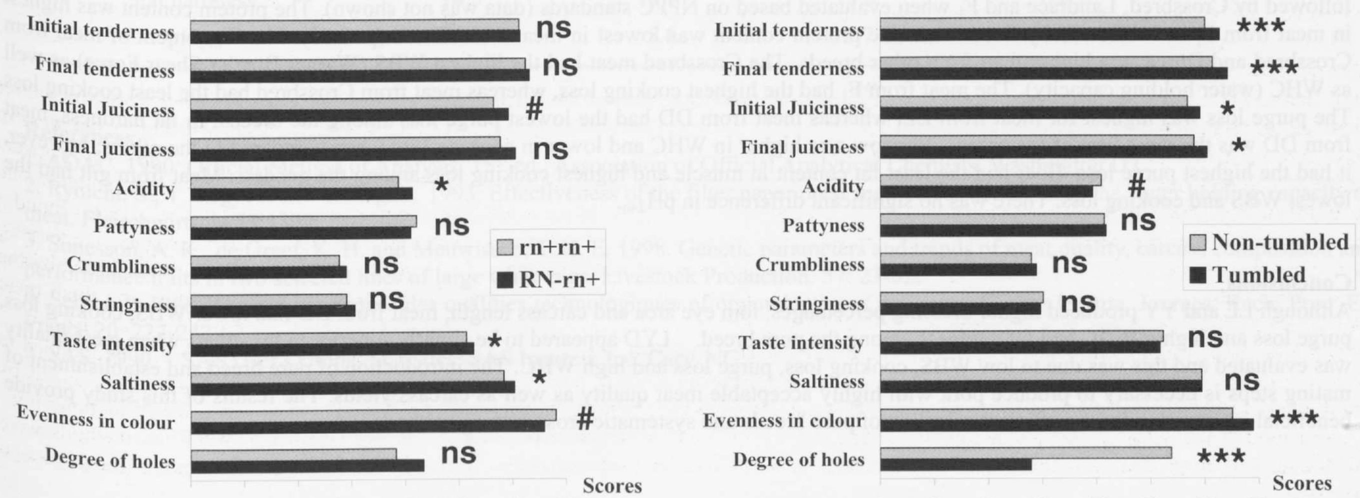

Figure 1. Effect of RN genotype and tumbling conditions on sensory properties of cured-smoked loins.
Level of significance: ns = $p>0.05$; # = $p\leq0.10$; * = $p\leq0.05$; ** = $p\leq0.01$; *** = $p\leq0.001$.