INFLUENCE OF REARING CONDITIONS OF CULL SOW (INDOOR *VS* OUDOOR) ON RAW MEAT COMPOSITION AND CURED BACON QUALITY AND SENSORIAL TRAITS

A.S. Guillard[1], B. Lebret[2], F. Berger[3], J.L. Vendeuvre[1]
[1]CTSCCV, 7, Avenue du Général de Gaulle, 94704 Maisons Alfort Cédex, France, [2]INRA, Unité Mixte de Recherches sur le Veau et le Porc, 35590 Saint-Gilles, France, [3]Chambre d'Agriculture de la Mayenne, 19, rue de l'Ancien Evêché, BP 1229 53012 Laval Cédex, France.

BACKGROUND

Outdoor rearing corresponds to an alternative way to the conventional confined one. These conditions affect pork meat quality (Enfält *et al* 1997, Lebret *et al* 1998, Nilzen *et al* 2001). This study is a first attempt to compare these two ways of rearing, in order to evaluate quality changes that can be valuable for cull sow meat. The main use of cull sow by meat industry is its transformation in cured bacon or in dry sausages. As cured bacon process preserves muscle integrity, the effect of rearing conditions was tested on this product.

OBJECTIVES

The effect of outdoor rearing of cull sow on raw meat characteristics, and on cured bacon quality was studied. The results observed on the *Longissimus*, from the raw muscle to the sensory quality of bacon are presented. Carcass traits and composition of muscular and back fat tissues are detailed in an other communication (Lebret *et al*).

METHODS

Animals: Twelve cull sows (*Large white X Landrace*), 6 reared indoor and 6 outdoor (on pasture with 650 m²/sow during gestation and 500 m²/sow during lactation) were studied. They were slaughtered eleven days after the last weaning, in three groups, each group containing the same number of indoor and outdoor animals.

Raw muscles analysis : Forty five minutes after slaughter, samples of *Longissimus* muscle were cut and immediately frozen in liquid nitrogen for pH1 determination, after grinding in iodoactetate buffer. Other muscle samples were ground, frozen, freeze-dried and stored at –20°C for lipid analysis (Folch *et al* 1957, Morrisson and Smith 1964). Two days after slaughter, muscles were cut, pHu was measured, and individual right side muscles were stored under vacuum at 4°C. The left side muscles were put individually under vacuum and stored at –20°C for bacon processing. Seven days after slaughter, colour was measured as coordinates CIE L*a*b* (D_{65}, 10°, Minolta CM2002). Thiobarbituric acid reactive substances (TBArs) were measured (Witte *et al* 1970), after 7 days storage at 4°C and 3 months storage at –18°C. Oxydative stability under chemical oxydation was also measured (Gattelier *et al* 1996).

Cured bacons analysis : Frozen left side muscles were cured, but not smoked, in order to avoid smoke flavour interference on the sensorial differences between the two ways or rearing. Sensory evaluation of aspect, texture and flavour, was performed by a 12 members professional trained panel. Training was performed on the ham side half of the *Longissimus* and measurements on the shoulder side half, with two repetitions for each muscle. Descriptor scores were recorded on a structured scale graduated from 0 to 10. Colour and TBArs were measured as described above. Hexanal content was measured by static Head Space extraction and Gas chromatographic analysis (Wu *et al* 1998).

Data analysis : All data were analysed under SAS® GLM procedure (1989). For physico-chemical data, rearing condition was considered as main variable and slaughter date as covariable. When an effect was significant, means were compared by the Tukey test. For sensory analysis, juge and rearing conditions effects and their interaction were tested, and different means were compared by the Newman-Keuls test.

RESULTS AND DISCUSSION

Raw muscles ***(table 1):*** No significant differences between indoor and outdoor rearing were observed on raw *Longissimus* muscle for pH1, pHu, glycolytic potential (GP), colour (L* a* b*), in agreement with Gentry *et al* (2000) for pH and GP, whereas Enfält *et al* (1997) reported higher GP and lower pHu values in that muscle of outdoor-reared pigs. A high increase in α-linolenic acid content was observed in the *Longissimus* of outdoor reared sows, in relation with its high level in the grass (Rey *et al* 1997), and in accordance with Nilzen *et al* (1998). However, this neither influenced the amounts of PUFA, SFA and MUFA, nor the oxidation level and oxidability of raw meat.

Cured bacons :

- ***Sensory evaluation (figure 1)***: Significant effects of rearing conditions were observed. The colour of bacons from outdoor reared animals was less intense in red, the aspect less homogenous, and the texture less crunchy and less firm. They also tended to be more easy to cut and fatty aroma was slightly increased.
- ***Physico-chemistry (table 2)*** : No significant differences were observed, but a higher value for b*. This difference in the b* value, with no modification of the a* value, could explain the coulour difference observed by sensory evaluation, by increase of yellow tint.

Table 1 : *Longissimus* raw muscle quality (Means ± standard deviation and level of significance, ns=not significant).

	Indoor	Outdoor	Sign. level
pH1	6.2±0.2	6.0±0.3	ns
pHu	5.5±.0.2	5.5±0.1	ns
Glycolytic Potential (µmol lactate equiv./g muscle)	188±23	184±6	ns
Fatty acid content (mg/g muscle)			
Saturated (SFA)	3.77±1.69	3.83±1.02	ns
Monounsaturated (MUFA)	5.58±3.05	5.39±1.43	ns
Polyunsaturated (PUFA)	1.80±0.36	1.91±0.20	ns
α-linolenic acid	0.05±0.03	0.13±0.03	p<0.01
Colour			
L*	45.9±2.3	44.4±3.0	ns
a*	9.3±2.4	10.2±1.3	ns
b*	8.1±2.9	8.4±1.6	ns
TBARS index (µg/g muscle), **after**			
7 days storage (4°C)	2.3±0.5	1.9±0.5	ns
3 month storage (–18°C)	2.4±0.4	2.4±0.3	ns
90 min. chem. Oxydation	7.3±1.4	7,5±0.8	ns

CONCLUSION

This explorative study of outdoor rearing effect on cull sow showed, despite a restrained number of animals, a nutritional benefit, as the content of alpha linolenic acid (n-3 series polyunsaturated fatty acid) in *Longissimus* was significantly increased. By sensory evaluation, some differences in texture and colour of cured bacon were also observed. A further study should be made on the nutritional aspect, in order to assess if the differences observed on raw muscle are preserved after the cured bacon process. Concerning the sensory quality, consumer studies should be realised, including all aspects of the outdoor rearing choice, to determine if this kind of product is in adequation with consumer needs and preferences.

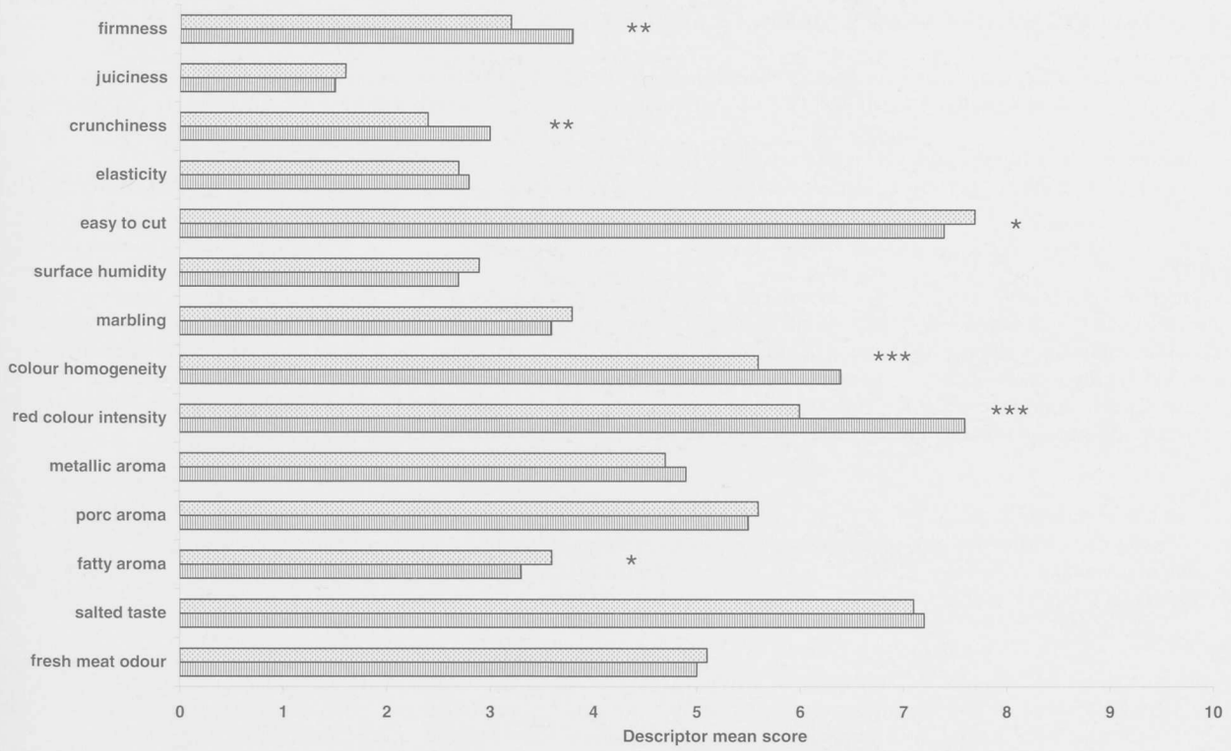

Figure 1 : Effect of rearing conditions on sensorial descriptor mean scores (indoor outdoor). Means which differ significantly are indicated as follows : *** $p<0.01$, ** $p<0.05$ and * $p<0.1$.

Table 2 : Effect of rearing conditions on bacon technological yield, colour and oxydation level (a= see table 1)

	Indoor	Outdoor	Sign. level.[a]
Technological yield (%)	97±3	99±2	p=0.12
Colour			
L*	35.4±4.2	37.0±3.9	ns
a*	13.7±2.5	13.1±1.6	ns
b*	1.6±0.7	3.3±1.2	p<0.01
Oxydation level after 1 month storage (4°C)			
TBArs index (µg/g muscle)	0.4±0.2	0.3±0.1	ns
Hexanal (µg/100g muscle)	0.25±0.02	0.24±0.03	ns

REFERENCES

- Enfält, A.C., Lundström, K., Hansson, I., Lundeheim, N., Nyström, P.E., 1997. Effects of outdoor rearing and sire breed (Duroc or Yorkshire) on carcass composition and sensory and technological meat quality. *Meat Science*, 45, 1-15.
- Folch, J., Lee, M., Sloane Stanley, G. H., 1957. A simple method for the isolation and purification of total lipids from animal tissues. Journal of Biological Chemistry, 226, 497-509.
- Gattelier P., Mercier Y., Remignon H., Renerre M., 1996. Influence du mode d'alimentation sur l'oxydation des lipides et des protéines de la viande de dinde. Viandes et Prod. Carnés 17 (6), 300-302.
- Gentry, J.G., Blanton, J.R., McGlone, J.J., Morrow-Tesch, J.L., Miller, M.F., 2000. Pork quality and muscle characteristics of pigs finished indoors or outdoors during the winter months. Journal of Animal Science, 78, Suppl. 1, pp. 158.
- Lebret, B., Massabie P., Juin H., Mourot J., Chevillon P., Le Denmat M., 1998. Influence of pig housing on muscular and adipose tissue traits, and technological and sensory quality of dry cured hams. 44th International Congress of Meat Science and Technology, Barcelona, Spain, 1058-1059.
- Morrisson, W.R., Smith, L.M., 1964. Preparation of fatty acid methyl esters and dimethylacetals from lipids with boron fluoride-methanol. Journal of Lipid Research, 5, 600-608.
- Nilzen, V., Enfält, A.C., Lundström, K., Dutta, P.C., Babol, J., Lundeheim, N., 1998. Free range rearing of pigs with access to pasture grazing – Effect on fatty acid composition and lipid oxidation products. 44th International Congress of Meat Science and Technology, Barcelona, Spain, 1054-1055.
- Rey, A.I., Lopez-Bote, C.J., Sanz Arias, R., 1997. Effect of extensive feeding on α-tocopherol concentration and oxidative stability of muscle microsomes from Iberian pigs. Animal Science, 65, 515-520.
- SAS 1989. SAS User's Guide : Statistics. SAS Ins. Inc., Cary, NC, USA.
- Witte V.C., Krause G.F., Bailey M.E., 1970. A new extraction method for determining 2-thiobarbituric acid values of pork and beef during storage. Journal of Food Science, 35, 582-585.
- Wu Y., Hamouz F., Schnepf M., 1998. Factors affecting static headspace-gas chromatographic analysis of lipid oxidation in precooked meat. Journal of Agricultural and Food Chemistry, 46 (9), 3677-3682.