EFFECT OF PIG GENOTYPE AND MAGNESIUM – TRYPTOPHAN SUPPLEMENTED DIETS ON THE MEAT SENSORIAL ATTRIBUTES AND TEXTURAL PROPERTIES

Núria Panella, Maria Font i Furnols, Joan Tibau[1], Joaquim Soler[1], Maria Àngels Oliver and Marta Gil.*

IRTA. Centre de Tecnologia de la Carn. Granja Camps i Armet. 17121 Monells. Girona. Spain

[1]IRTA. Centre de Control Porcí. Veïnat de Sies. 17121 Monells. Girona. Spain.

Key Words: genotype, natural tranquillizers, pork, texture, sensory

Introduction

From the animal welfare point of view, the handling of animals before slaughter is one of the most important causes of stress in pigs. Together with genetics, the *antemortem* treatment has an important influence on the final meat quality obtained.

A supplementation of magnesium (Mg) or tryptophan (Trp) in the diet of pigs may reduce the effect of stress by reducing the concentration of cortisol and cathecholamines in plasma (Kietzmann and Jablonski, 1985), or by enhancing the synthesis of brain serotonin (Leathwood, 1987; Peeters et al., 2004), respectively.

Several authors have analyzed the effect of Mg-supplemented diets (D'Souza et al.,1998, 2000; Swigert et al., 2004) or Trp-supplemented diets (Adeola and Ball, 1992; Henry et al., 1996) on pork meat quality (color, water holding capacity). Short-term supplemented diets (2-5 days) were found effective (D'Souza et al., 1998; Frederick et al., 2004; Hamilton et al., 2002). The improvement of meat quality by the use of Mg-supplemented diets seems to be related with the stress-susceptibility of the pigs (Apple et al., 2000; Caine et al., 2000) and also with the degree of stress suffered by the animals before slaughter (Souza et al., 2000; Geesink et al.,2004; Font i Furnols et al., 2004).

Tryptophan is a precursor of skatole, one of the compounds responsible for the boar taint problem in pork (Vold, 1970; Walstra and Maarse, 1970). Thus, it is interesting to study the effect of Trp-supplemented diets on the sensory characteristics of meat.

In the present work, the effect of supplementation of the diet of pigs from two halothane genotypes with Mg and Trp on the sensorial attributes and on the meat texture is presented.

Objectives

The aim of this study was to evaluate the effect of the supplementation of the diet with Mg and Trp on the sensorial attributes and on the meat textural properties of pigs from two different genotypes with respect to the halothane gene (NN, negative; nn, positive).

Methodology

Animals, diets and pre-slaughter treatment: Seventy-one entire male pigs (36 NN and 35 nn) from Pietrain, Landrace and Large White lines (average live weight: 108.51± 8.32 kg) were used. They were housed individually and fed the same diet until 5 days before slaughter, when three diet groups were established for each genotype: control group, with no supplement; Mg + Trp group, same diet supplemented with 1.2 g elemental Mg and 8 g L-Trp per kg; Trp group, same diet supplemented with 8 g L-Trp per kg. The animals were submitted to the following *antemortem* conditions: they were mixed in the truck according to diet and genotype, and transported for one hour from the farm to the experimental abattoir on secondary roads; the lairage time was about 30 min for the first animal slaughtered. They were stunned with 90% CO_2 and slaughtered. The animals from the 6 groups (2 genotypes x 3 diets) were slaughtered alternatively.

Sampling: Longissimus muscle samples were obtained at 24 h *postmortem*. Samples for sensorial analysis were taken at the last rib level, and those for texture measurements at the ¾ rib level from the last rib. They were vacuum-packed in aluminium bags and kept at –20ºC until analysis.

Sensorial analysis

1. Selection and training of the assessors and elaboration of the descriptive profile. Assessors were selected for their sensitivity to androstenone and skatole. This was done by conducting a direct olfactory test on vials containing standard androstenone or skatole. A total of 10 panelists were selected and participated in the training sessions and in the elaboration of the descriptive profile, according to Font i Furnols et al. (2000) with some modifications. The descriptive profile included the following attributes:
    - *Odor:* androstenone, skatole, sweet, pig.
    - *Flavor:* androstenone, skatole, sweet, metal, pig, sour.
    - *Texture:* hardness.
    - The panelists evaluated the intensity perceived of each attribute on a 10 cm-long non-structured lineal scale, anchored at 0.5 cm of the extremes, with the terms ‘none’ and ‘very high’.
2. *Experimental design:* Ten sessions were carried out. In each session the panelists evaluated odor, texture and flavor of 6 samples, one of each genotype*diet.
    - The samples were presented to the panelists in a monadic way. Each assessor received the samples in a different order, designed to avoid the first sample and carry-over effect (Macfie et al., 1989). The evaluations were performed in a standardized sampling room (ISO 8589, 1988).
3. *Sample preparation:* The loin samples were thawed at 4ºC/24h, and then cut into slices of 1.5 cm thickness. Each slice was cut into 4 pieces 1.5 cm wide; each piece contained subcutaneous fat (Agerhem and Dijksterhuis, 1997). These pieces were placed in closed test-tubes (10 cm long with an inner diameter of 2 cm) and heated in a preheated oven at 175ºC until they reached an internal temperature of 75ºC. Then they were served to the panelists.

Textural analysis (Warner-Bratzler test): The loins (1.5 cm thickness) were thawed at 4ºC/24 h in their vacuum-packed plastic bags and then cooked in an oven at 110ºC, until they reached an internal temperature of 75ºC (25 min). They were cooled down at room temperature (20±2ºC) before the analysis. The samples were obtained by cutting 6 to 8 rectangles of 1.5 x 1.5 cm of cross section, obliquely (45º) to the muscle fiber direction (Guerrero and Guàrdia, 1999; Poste et al., 1993). They were cut using a Warner-Bratzler shear blade with a triangular slot cutting edge in a Universal testing machine - MTS Alliance RT/5. The samples were cut at a crosshead speed of 2 mm/s. The average value for each sample was recorded (mean of 6 to 8 replicates).

Maximum shear force (N) (Moller, 1980), shear firmness (N/cm) (Brady and Hunecke, 1985) and the total work performed to cut the sample (Kg.cm) were recorded.

Statistical analysis: The GLM procedure of SAS software (SAS, 1999) was used. For the sensory analysis genotype, diet and the interaction between them (if significant) were considered as fixed effects. Panelist and session within panelist were considered as blocking variables. For the texture analysis genotype, diet, and the interaction between them (if significant) were considered as fixed effects. When the cooking day was significant it was included in the model as a blocking variable. Significant differences between least squares means were obtained after applying the Tukey test.

Results & Discussion

Table 1 shows the least squares means and root mean squared error of the scores of sensorial attributes evaluated by the trained panelists. Some differences were found between genotypes as well as between diets. Loins from halothane positive animals presented significantly lower androstenone and skatole odor and flavor than halothane negative animals, suggesting that meat from nn pigs could present less boar taint problems. Halothane positive pigs also presented higher sweet odor. As expected, hardness was evaluated higher in nn than in NN pigs, since PSE meat is less tender than normal meat. Moelich et al. (2003) find significant differences in juiciness, but not in tenderness according to the halothane genotype. With respect to the diet, the Mg + Trp group showed lower androstenone odor than the control group, and lower skatole flavor than both the control and the Trp groups. The group of diet did not affect hardness.

One of the objectives of this study was to ascertain if the Mg and/or Trp-supplemented diets would affect meat texture. No significant differences between genotypes or diets (Table 2) were found in any of the texture parameters measured by the Warner-Bratzler test. With respect to the genotype, this result was in accordance with De Smet et al. (1995, 1996), who report no differences due to halothane susceptibility. In contrast, Moelich et al. (2003) find higher shear force values for nn than for NN animals. In the case of diets, the lack of differences could be due to the high drip losses found in the three groups, which even though they were significantly lower in the supplemented diets, they were still high (7.34%) (Panella et al., 2004).

Conclusions

Supplementation of (Mg + Trp) or Trp in the diet of pigs from the two different genotypes did not affect the boar taint perception assessed by the panel test, whereas, from the two genotypes, the nn pigs could present less boar taint problems. The hardness evaluated by the panelists was higher in meat from the nn genotype. The instrumental texture properties of the meat (Warner-Bratzler test) did not vary between genotypes or diets.

Acknowledgements

This work was financed by CICYT AGL2002-00777.

References

Adeola O., Ball R.O. (1992) J. Anim. Sci. 70, 1888–1894.

Agerhem, H. and Dijksterhuis, G. (1997). Proceedings of the 43rd ICoMST, pp. 252–253. Auckland, New Zealand.

Apple J.K., Maxwell C.V., deRodas B., Watson H.B., Johnson Z.B. (2000) J. Anim. Sci. 78, 2135–2143.

Brady, P.L., Hunecke M.E. (1985). J. Food Sci., 50, 300–303.

Caine W.R., Schaefer A.L., Aalhus J.L., Dugan M.E.R. (2000) Can. J. Anim. Sci. 80, 175–182.

De Smet, S., Pauwels, H., Vervaeke, I., Demeyer, D., De Bie, S., Eeckout, W. Casteels, M. (1995) Anim. Sci. 61, 109.

De Smet, S.M., Pauwels, H., De Bie, S., Demeyer, D.I., Callewier, J., Eeckout, W. (1996) J. Anim. Sci. 74, 1854–1863.

D'Souza D.N., Warner R.D., Leury B.J., Dunshea F.R. (1998) J.Anim.Sci. 76, 104–109.

D'Souza D.N., Warner R.D., Leury B.J., Dunshea F.R. (2000) Aust. J. Agric. Res. 51, 185–189.

Font i Furnols, M., Guerrero, L., Serra, X., Rius, M.A, Oliver, M.A. (2000) J. Sensory Studies, 15(4), 393–409

Font i Furnols, M., Panella, N., Fàbrega, E., Velarde, A., Oliver, M.A., Soler, J., Gil, M. (2004) 2004 ADSA-ASAS-PSA Joint Annual Meeting, Saint Louis, Missouri, USA

Frederick, B.R., van Heugten, E., See, M.T. (2004) J.Anim.Sci. 82, 1454–1460.

Hamilton D.N., Ellis M., Hemann M.D., McKeith F.K., Miller K.D., Purser K.W. (2002) J. Anim. Sci. 80, 1586–1592.

Henry Y., Sève B., Mounier A., Ganier P. (1996) J. Anim. Sci. 74, 2700–2710.

Geesink G.H., van Buren R.G.C., Savenije B., Verstegen M.W.A., Ducro B.J., van der Palen J.G.P., Hemke, G. (2004) Meat Sci. 67, 1–6.

Guerrero, L., Guàrdia, M.D. (1999). ITEA, VIII Jornadas sobre producción animal, 20 (1): 83–85. Zaragoza, España.

ISO 8589, 1988. Sensory analysis. Guide for the installation of a chamber for sensory analysis. Organization for standardisation, pp 1–10, Genève, Switzerland.

Kietzmann M. and Jablonski H. (1985) Prakt. Tierz. 661, 331.

Leathwood, P.D. (1987) Proc. Nutr. Soc. 46, 143

MacFie, H.J., Bratchell, N., Greenhoff, K, Vallis, L. V. (1989) J. Sensory Studies 4, 29–149.

Moelich, E.I., Hoffman, L.C., Conradie, P.J. (2003) Meat Sci. 63, 333–338.

Møller, A. (1980) Meat Sci. 5, 247–260

Panella, N., Font i Furnols, M., Oliver, M.A., Rodríguez, P., Velarde, A., Tibau, J., Gil, M. (2004) Proceedings of the 50th ICoMST, Helsinki, Finland.

Peeters E., Driessen, B., Steegmans, R., Henot, D., Geers, R. (2004) J. Anim. Sci. 82, 2410–2420.

Poste, L.M., Butler, G., Mackie, D., Agar, V.E.,Thompson, B.K. (1993) Food quality and preference 4, 207–214

SAS (1999) SAS for windows release 8e-2000. SAS Institute Inc., Cary, NC, USA.

Swigert K.S., Mc Keith F.K., Carr T.C., Brewer M.S., Culbertson M. (2004) Meat Sci 67, 81–86.

Vold, E. (1970). Meldinger Nordandbruckhoegskole 49, 1–25.

Walstra, P., Maarse, H. (1970) Onderzoek geslachtgeur van mannelijke mestvarkens. Researchgroep Vlees en Vleesvare. T.N.O., Zeist. The Netherlands. Rap. C-147 and 2: 1–30.

Tables

Table 1. Least squares means and root mean squared error (RMSE) of sensorial attributes evaluated by a panel test in the loin of pigs from the two genotypes fed the three groups of diets

	Genotype			Group of Diet*			
ODOR	NN	nn	Sig	Control	Mg + Trp	Trp	RMSE
Androstenone	2.36	1.82	**	2.44[a]	1.71[b]	2.12[ab]	1.88
Skatole	3.77	2.78	***	3.31	3.02	3.51	2.07
Sweet	1.84	2.12	*	1.95	2.09	1.89	1.11
Pig	3.91	4.11	ns	3.78	3.82	4.43	1.29
TEXTURE							
Hardness	3.75	4.96	***	4.44	4.45	4.19	1.62
FLAVOR							
Androstenone	0.94	0.70	*	0.96	0.73	0.76	1.08
Skatole	2.20	1.38	***	1.97[a]	1.41[b]	1.98[a]	1.69
Sweet	1.86	1.81	ns	1.75	1.9	1.85	0.98
Metallic	1.85	2.06	ns	1.98	2.0	1.88	1.12
Pig	2.94	2.99	ns	2.89	2.77	3.23	1.26
Sour	0.18	1.49	ns	0.13	2.02	0.35	1.33

* Different superscripts within a row indicated significant differences between groups of diet ($P<0.05$); ns: non significant.

Table 2. Least squares means and root mean squared error (RMSE) of textural properties (Warner-Bratzler test) of the loin of pigs from the two genotypes fed the three groups of diets

	Genotype			Group of Diet				
	NN	nn	Sig.	Control	Mg + Trp	Trp	Sig.	RSME
Maximum Shear Force (N)	50.30	50.48	ns	52.39	51.65	47.13	ns	9.53
Shear firmness (N/cm)	70.83	75.99	ns	75.42	74.00	70.81	ns	14.12
Total Work (kg.cm)	6.38	6.39	ns	6.84	6.34	5.97	ns	1.18

ns: non significant.