SHORT-TERM FEEDING STRATEGIES AND PORK QUALITY

Geesink, G.H., Savenije, B., van der Palen, J.G.P. and Hemke, G.
[1]CCL Research, PO Box 107, NL-5460 AC, Veghel The Netherlands

Background

Results from a number of studies showed that short-term feeding of supra-nutritional levels of some nutrients may improve water-holding capacity (WHC) of pork. These nutrients include magnesium, tryptophan and vitamin C (see Pettigrew & Esnaola, 2001 for a review). Magnesium supplementation resulted in large improvements in WHC for pigs that were exposed to severe acute stress prior to slaughter (D' Souza *et al.*, 1998, 1999, 2000). The effects are less clear when pigs are treated according to routine slaughter procedures (Apple *et al.*, 2000, 2001, Caine et al., 2000). The effects of vitamin C and tryptophan have been less intensively studied and the results are not conclusive (Adeola & Ball, 1992, Cabadaj *et al.*, 1983, Henry *et al.*, 1996, Kremer *et al.*, 1999). Feeding supplemental vitamin E during the grower-finishing phase has also been reported to improve WHC (Asghar et al., 1991, Cheah et al., 1995). There are no reports on the effect of short-term supplementation of vitamin E on WHC, but feeding 1 g of supplemental vitamin E per day during 7 days increased muscle vitamin E content in pork from 2.5 to 100 mg/kg (Flachowsky *et al.*, 2000).

Objective

The objective of the present study was to determine whether short-term supplementation with magnesium acetate, tryptophan, vitamin E and vitamin C would improve WHC and color.

Methods

Cross-breed Pietrain x Yorkshire gilts and barrows (n=92) were fed a standard diet (n = 47) or a supplemented diet (n = 45) during 5 days before slaughter and consumed about 2.5 kg of the feed per day. The supplemented diet consisted of the standard diet with the addition of 6.8 g/kg feed grade magnesium acetate, corresponding to 1.19 g elemental magnesium per kg feed, 5 g/kg tryptophan, 500 mg/kg vitamin C and 500 mg/kg vitamin E. Supplement content was in the feed was verified by chemical analysis (Table 1). Pigs were slaughtered at a live weight of about 105 kg at a commercial slaughter plant. One day after slaughter about 25 cm of the longissimus muscle of the right carcass side, starting at the 4th lumbar vertebra, was collected and transported to CCL Research and stored at 4°C. The following day, the muscles were divided in 1.8 cm slices starting at the rostral end of the muscle. Slices 2, 4, 6 and 8 were used for determination of drip loss. The 3rd slice was used for pH determination and the 5th slice was used for color measurements. For determination of drip loss, two circular samples with a diameter of 4 cm were removed from the slices using a cork borer. The samples, 8 per muscle, were weighed, placed on display trays, covered with foil and stored for 5 days at 4°C. After storage, the samples were patted dry with paper towel, and drip loss (%) was determined by reweighing the samples. Color was determined, after blooming for 30 minutes, by measurement of L*-, a*-, and b* values using a Minolta Chromameter CR-210 (Minolta Co., Osaka, Japan). Color stability was determined after 6 days of display storage at 4°C on retail trays covered with oxygen permeable foil. A Radiometer PHM85 Precision pH meter equipped with a Radiometer PHC 2431 glass electrode (Radiometer, Brønshøj, Danmark) was used to determine the pH of the muscles. Five muscles of each treatment group were randomly selected for analysis of vitamin E content. Supplement concentrations in the standard and supplemented diet and muscle vitamin E concentration were determined by a commercial routine analysis laboratory (Nutricontrol, Veghel, The Netherlands). Data were analyzed using the SAS statistical software package (SAS Institute Inc., 1990) by means of Generalized Linear Models (GLM) using the following model: $Y_{ij} = Mean + Feed_i + error_{ij}$.

Results and discussion

A large variability in drip loss was observed, ranging from 2.5% to 11.6%. Ultimate pH, ranging from 5.27 to 5.71, explained 47% of the variation in drip loss. A question with regard to vitamin E supplementation was whether the supplementation period was sufficient to raise muscle vitamin E content. Flachowsky *et al.* (2000) reported an increase in vitamin E content from 2.5 to 100 mg/kg muscle as a result of feeding 1 g of supplemental vitamin E per pig per day during 7 days. In the present study, the pigs were fed an average of 2.5 kg feed per day, thus 1.25 g additional vitamin E per pig per day, but no raise in muscle vitamin E content was observed (Table 2). It appears unlikely that the two days difference in supplementation between the study of Flachowsky et al. (2000) and the present study would explain the difference in result. However, based on the present results, short-term feeding of high doses of vitamin E is not expected to improve meat quality. Supplementation with magnesium acetate, tryptophan, vitamin E and vitamin C did not result in improvement of water-holding capacity, color, or color stability (Table 2). Thus, short-term feeding strategies with these supplements appear of little value to improve pork quality. The correlation between ultimate pH and drip loss offers a more promising possibility to improve pork quality. In the present experiment a raise in ultimate pH of 0.1 unit equated to a decrease in average drip loss of 1.2%. Given that the heritability of ultimate pH is estimated at 0.52 (Stalder *et al.*, 2003), the relatively slow procedure of selecting for ultimate pH to improve pork quality appears more promising than a quick fix by short-term feeding strategies.

Conclusion

Short-term supplementation of the diet with magnesium acetate, trypthophan, vitamin E, and vitamin C is of little value to improve pork quality when pigs are not stressed beyond stress levels associated with routine slaughter procedures.

References

Adeola, O. & Ball, R.O. (1992). *Journal of Animal Science, 70*, 1888-1894.

Apple, J.K., Davis, J.R., Rakes, L.K., Maxwell, C.V., Stivarius, M.R. & Pohlman, F.W. (2001). *Meat Science, 57*, 43-53.

Apple, J.K., Maxwell, C.V., deRodas, B., Watson, H.B. & Johnson, Z.B. (2000). *Journal of Animal Science*, 78, 2135-2143.

Asghar, A., Gray, J.I., Booren, A.M., Gomaa, A., Abouzied, M.M. & Miller, E.R. (1991). *Journal of the Science of Food and Agriculture, 57*, 31-41.

Cabadaj, R., Pleva, J. & Mala, P. (1983). *Folia Veterinaria 27 (2)*, 81-87.

Caine, W.R., Shaeffer, A.L., Aalhus, J.L. & Dugan, M.E.R. (2000). *Canadian Journal of Animal Science, 80*, 175-182

Cheah, K.S., Cheah, A.M. & Krausgrill, D.I. (1995). *Meat Science, 39*, 255-264.

D'Souza, D.N., Warner, R.D., Leury, B.J., & Dunshea, F.R. (1998). *Journal of Animal Science, 76*, 104-109.

D'Souza, D.N., Warner, R.D., Leury, B.J., & Dunshea, F.R. (1999). *Meat Science, 51*, 221-225.

D'Souza, D.N., Warner, R.D., Leury, B.J., & Dunshea, F.R. (2000). *Australian Journal of Agricultural Research, 51*, 185-189.

Henry, Y., Sève, B., Mounier, A. & Ganier, P. (1996). *Journal of Animal Science, 74*, 2700-2710.

Flachowsky, G., Rosenbauer, H., Berk, A., Vemmer, H. & Daenike, R. (2000). In *Quality of meat and fat in pigs as affected by genetics and nutrition, Proceedings of the joint session of the EEAP commisions on pig production, animal genetics and animal nutrition.* (pp. 233-236) Wageningen, The Netherlands: Wageningen Pers.

Pettigrew, J.E. & Esnaola, M.A. (2001). *Journal of Animal Science 79(E. Suppl.)*, E316-342.

SAS Institute Inc. (1990). *SAS/STAT User's Guide, Version 6, Fourth Edition, Volume 2*, Cary, NC, USA.

Stalder, K.J., Saxton, A.M., Miller, R.K. & Goodwin, R.N. (2003). *Journal of Animal Science, 81*, 611-616.

Table 1: Supplement concentrations in the control and supplemented diet.

Trait	Control	Supplemented
Magnesium (g/kg)	1.94	3.09
Tryptophan (g/kg)	1.65	5.94
Vitamin E (mg/kg)	43	571
Vitamin C (mg/kg)	3	471

Table 2: Meat quality characteristics and muscle vitamin E content a affected by supplementation of the diet with magnesiumacetate, tryptophan, vitamin E, and vitamin C (mean ± S.D.; n = 92)

Trait	Control diet	Supplemented diet
Drip loss (%)	6.8 ± 1.6	7.1 ± 1.8
L*-value 2 days p.m.	50.3 ± 2.4	49.9 ± 2.7
a*-value 2 days p.m.	15.3 ± 0.9	15.4 ± 0.8
b*-value 2 days p.m.	5.8 ± 0.7	5.9 ± 0.7
L*-value 8 days p.m.	52.7 ± 2.6	52.2 ± 2.5
a*-value 8 days p.m.	14.8 ± 1.1	15.1± 1.2
b*-value 8 days p.m.	8.5 ± 0.5	8.6 ± 0.5
Muscle pH	5.47 ± 0.10	5.46 ± 0.09
Vitamin E (mg/kg; n = 5)	5.6 ± 0.8	5.6 ± 0.4