LOIN MARBLING IS ASSOCIATED WITH PIG GROWTH RATE AND OVERALL CARCASS LEANNESS

S. Jungst, B. Fields, A. Williams, A. Sosnicki* and C. Booher

PIC USA, P.O. Box 348, Franklin KY, 42135-0348 USA. Email: Andrzej.Sosnicki@pic.com

Keywords: pork, meat quality, marbling, growth, lean

Introduction

There is increasing interest in the degree of marbling in fresh pork loins in the pork industry. This is being led by the ever increasing amount of fresh pork exported to Japan and used by the food service industry. Although contradictory studies have been published on the impact of increased marbling level on consumer acceptability, most agree pork should have 2-4% intramuscular fat (IMF). Fernandez *et al.*, (1999b) and Brewer *et al.*, (2001) established that more highly marbled chops were juicer, more tender, and more flavoursome, but they appeared paler and were less likely to be purchased by consumers. Both Casteels *et al.*, (1994) and Rincker *et al.*, (2005) agreed IMF levels had little effect on the sensory properties of fresh pork. A desirable level of 2.5% to 3.0% was called for by DeVol *et al.*, (1988) while Fernandez *et al.*, (1999a) determined that flavour and juiciness were enhanced when IMF levels were over 2.5%. Others have suggested a threshold of 2% IMF to ensure desirable eating quality (Bejerholm and Barton-Gade, 1986). A survey of the US pork industry claimed the average marbling score of fresh pork loins in the retail case was 2.37 (AMSA, 2003), suggesting there is still a need to increase the amount of marbling in fresh pork loins.

While debating the importance of increased marbling levels is simple, putting this into practice is not. The amount of marbling in pork loins is known to be directly correlated with the amount of backfat (Huff-Lonergan, 2002). Furthermore, studies that have looked at the impact of nutrition on IMF and marbling levels demonstrated IMF can be increased by decreasing the protein:digestible energy ratio or feeding increased levels of fat during finishing, but at the detriment of growth rate (Cisneros *et al.*, 1996; Eggert *et al.*, 1998).

Without a premium payment system or a pre-defined bonus structure for producers delivering pigs with increased levels of marbling, the economic impact seems to be negative. However, if there were a trade off with certain production factors such as fatter carcasses but with faster growth, the additional costs of producing pigs with increased marbling may be nullified. Objectives of this study were to look beyond the well documented eating quality parameters associated with marbling and to investigate the production factors that affect the overall performance of the pig, including the marbling levels.

Materials and Methods

PIC commercial sires of predominantly Duroc (19 boars), RN⁻ Hampshire (23 boars), and Synthetic (21 boars) genetic backgrounds were used in this study. A total of 1,903 pigs were farrowed by Camborough 22 or 23 sows at a PIC commercial research farm and were harvested at a commercial processor in the U.S. Market weights ranged from 88 kg to 170 kg with a mean of 127.7 kg. Feed intake was measured on individual pigs using FIRE (Feed Intake Recording Equipment) feeders. The pigs were fed corn-soy based diets formulated to meet PIC's nutrient recommendations for grow – finish pigs. Paylean™ was not fed. Carcasses were measured for backfat and loin depth using a Fat–O–Meater. Subjective marbling scores were assigned using the National Pork Board score of 1 (devoid) to 10 (abundant) (NPB, 1999) following visual observation of the sirloin end of each boneless loin. Data were analyzed using SAS PROC MIXED (SAS Inst., Inc., Cary, NC).

Results and Discussion

Growth rate and carcass leanness are major determinants of the amount of marbling in boneless loins. Least square means are presented in Table 1 for the growth, carcass, and meat quality traits by subjective loin marbling score. All genotypes performed in a similar manner as there was no interaction between genotype and marbling score. Days to 125 kg showed a linear decrease of -.97 days for each 1 unit increase in subjective marbling score. For average daily gain, there was a curvilinear relationship indicating that the pigs grew faster but the rate of the increase changed at the higher marbling scores. Feed conversion was better at the higher levels of marbling and improved by .017 for each 1 unit increase in marbling score. Carcasses that displayed more backfat thickness, less loin depth, and a lower percentage of carcass lean had greater amounts of marbling. Furthermore, there was a linear relationship between subjective marbling score and loin pH, with loin pH increasing by .022 for each 1 point increase in marbling score. There was a curvilinear relationship between subjective marbling score and subjective loin colour score. The subjective loin colour score increased, but at a faster rate at the higher levels of marbling.

Table 1: Production, carcass and loin meat **quality** means **by subjective marbling** score.

	Subjective Loin Marbling Score[a]						
Trait	1	2	3	4	5	Linear	Quadratic
Production traits	n = 646	n = 538	n = 234	n = 173	n = 98		
Average daily gain, g /day	889	903	907	925	907	.012**	- .007*
Age at 125 kg, days	173.0	172.1	171.0	168.7	169.8	- .970***	.207
Feed conversion, kg feed / kg gain	2.51	2.51	2.50	2.42	2.47	- .017*	.001
Carcass traits (adj. for carcass wt.)	n = 681	n = 574	n = 225	n = 187	n = 101		
Hot carcass weight, kg	95.8	97.4	96.1	95.0	93.3	- 1.639***	- 1.031**
Backfat thickness[b], mm	18.5	18.5	19.1	19.8	20.6	.021***	.004†
Loin depth[b], mm	59.4	58.4	58.7	57.9	57.9	- .016*	.003
Lean[b], %	54.7	54.5	54.3	53.7	53.3	- .357***	- .049
Loin meat quality traits	n = 694	n = 618	n = 258	n = 192	n = 103		
$pH_{24\text{-hours}}$	5.64	5.67	5.67	5.69	5.73	.022***	.003
Subjective colour score, (1 to 6)	2.94	3.07	3.10	3.26	3.55	.141***	.032***
Minolta L*	48.41	48.58	49.02	48.92	48.61	.076	- .106

[a] Subjective marbling scores based on the National Pork Board scale of 1 (devoid) to 10 (abundant).
[b] Carcass traits were adjusted to a 96.1 kg hot carcass weight.
†P < .10, *P < .05, **P < .01, *** P < .001

Conclusions

Loin marbling is significantly affected by growth rate and overall leanness. Increased levels of marbling will result in a lower lean percentage, but this will be counteracted by faster growth rates and better feed conversion. Muscle colour and pH will also be improved in these carcasses. Based on the known relationships between pH and muscle colour it is expected that water holding capacity and tenderness may be improved as well.

References

American Meat Science Association (2003). Benchmarking Value in the Pork Supply Chain: Quantitative Strategies and Opportunities to Improve Quality – Final Report. AMSA, Savoy, IL, USA.

Bejerholm, C. and Barton-Gade, P.A. (1986). Effect of intramuscular fat level on eating quality of pig meat. In: Proceedings of 32nd Meeting of European Meat Research Workers (pp. 389-391). Gent, Belgium.

Brewer, M.S., Zhu, L.G. and McKeith, F.K. (2001). Marbling effects on quality characteristics of pork loin chops: consumer purchase intent, visual and sensory characteristics. Meat Science, 59: 153-163.

Casteels, M., Van Oeckel, M.J., Boschaerts, L., Spincemaille, G. and Boucque, Ch.V. (1994). The relationship between carcass, meat and eating quality of three pig genotypes. Meat Science, 36: 253-269

Cisneros, F., Ellis, M., Baker, D.H., Easter, R.A. and McKeith, F.K. (1996). The influence of time of feeding of amino-acid deficient diets on the intramuscular fat content of pork. Animal Science, 63: 517-522.

DeVol, D.L., McKeith, F.K., Bechtel, P.J., Novakofski, J., Shanks, R.D. and Carr, T.R. (1988). Variation in composition and palatability traits and relationships between muscle characteristics and palatability in a random sample of pork carcasses. Journal of Animal Science, 66: 385-395.

Eggert, J.M., Farrand, E.J., Mills, S.E., Shinckel, A.P., Forrest, J.C., Grant, A.L. and Watkins, B.A. (1998). Effects of feeding poultry fat with supplemental beef tallow on pork quality and composition. http://ansc.purdue.edu/swine/swineday/sday1998/psd06-98.htm.

Fernandez, X., Monin, G., Talmant, A., Mourot, J. and Lebret, B. (1999a). Influence of intramuscular fat content on the quality of pig meat – 1. Composition of the lipid fraction and sensory characteristics of *m. longissimus lumborum*. Meat Science, 53: 59-65.

Fernandez, X., Monin, G., Talmant, A., Mourot, J. and Lebret, B. (1999b). Influence of intramuscular fat content on the quality of pig meat – 2. Consumer acceptability of *m. longissimus lumborum*. Meat Science, 53: 67-72.

Huff-Lonergan, E., Baas, T.J., Malek, M., Dekkers, J.C.M., Prusa, K. and Rothschild, M.F. (2002). Correlations among selected pork quality traits. Journal of Animal Science, 80: 2-10.

National Pork Board, (1999). Pork Quality Standards. Des Moines, IA, USA.

Rincker, P., Killefer, J., Matzat, P., McKeith, F., (2005). The effect of ractopamine and intramuscular fat content on sensory attributes in ork from pigs with similar genetics. In: Proceedings of 51st International Congress of Meat Science and Technology (pp. 77-78). 7-12 August 2005. Baltimore, Maryland, USA.