THE INFLUENCE OF SEX (ENTIRE MALES AND FEMALES) ON PORK GROWTH, CARCASS AND EATING QUALITY CHARACTERISTICS

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Background

An important contributor to the increased carcass lean contents, seen in the UK pig population over the past 20 years, has been the increased use of entire males for meat production, with entires now accounting for over 48% of the national kill. The practice of castrating male pigs is now considered inappropriate on the grounds of animal welfare and superior on-farm performance of entires compared to castrates, particularly in terms of feed efficiency and carcass lean content. Entire male carcases tend to be at the leading end of the leanness distribution curve, and are therefore the main subject of criticism as regards poorer meat quality. Concerns have also been expressed regarding the presence of cooking odours and abnormal flavours in meat from entire males. Although there has been a significant amount of research comparing entire males with either castrates and/or gilts, the majority of studies in the UK were carried out in the 1970s and early 1980s and were based on the Large White and Landrace breeds. In addition, as genetic progress continues the relative differences between the sexes may have changed. There is, therefore, a dearth of information regarding the relative merits of entire males and gilts from the wider range of breeds/lines that are more typical of those currently being used by the UK industry. As an integral part of an extensive study investigating the influence of lean tissue growth rate on pork eating quality (Blanchard et al, 1995), entire males and females were grown over a range of feeding regimens, and the resultant growth, carcass and eating quality characteristics are presented here.

Objective

To evaluate the influence of sex (entire males and females) on pork growth, carcass and eating quality characteristics.

Methods

Entire male and female pigs with 0, 0.25 and 0.50 Duroc genes were produced by mating Large White sires to F1 Large White x British Landrace and F1 hybrid (Duroc x (Large White x British Landrace)) females and Duroc sires to F1 Large White x British Landrace hybrid females respectively. Animals were reared from 30 to 90 kg liveweight on seven feeding regimens which involved combinations of diet formulation and feeding level (Blanchard et al, 1995). A diet of conventional energy and protein level (CEP; 14.2 MJ/kg DE, 205 g/kg CP, 10 g/kg lysine) and higher energy and lower protein diet (HELP; 14.7 MJ/kg DE, 166 g/kg CP, 7.0 g/kg lysine) were used. One treatment involved feeding the HELP diet ad libitum, with the other 6 treatments involving feeding the CEP diet either ad libitum, restricted, or in combinations of ad libitum and restricted. A total of 721 animals comprising equal numbers of the two sexes were used to estimate sex differences for growth, carcass, meat quality, and eating quality.

Tissue growth rates were predicted from regression equations (Engel and Walstra, 1991) based on P2 fat depths (from all 721 animals) or ham-joint dissection (from 366 animals), developed from sub-samples of animals that were subjected to full side dissection (126 animals). Pigs were weighed before being despatched for slaughter and were held in lairage for a period of at least 1 hour prior to slaughter. On the day of slaughter, hot carcass weight (kg), hot P2 fat depth, pH and temperature of longissimus dorsi (MLD) at 45 minutes post-mortem measurements were taken. Two days after slaughter, the following measurements were recorded on the left hand side of the carcass: *Rind side damage* - a subjective score of the degree of rind blemish (1 = clear to 5 = severely blemished scored against a photographic standard); *Subjective fat firmness* - leg and mid-back, scores were assessed by depressing the subcutaneous fat with the tip of a finger or thumb (using a scale of 1 = very soft to 8 = very hard); *Penetrometer fat firmness* (mid-back): a measure of firmness of the inner layer of backfat taken above the eye muscle using a portable penetrometer (the higher the score, the harder the fat); *EEL* (MLD and Biceps Femoris): a reflectance value was taken twice using an EEL reflectometer and an average value recorded (higher reading = paler, lower reading = darker); *pHu*: MLD and biceps femoris (BF); *Japanese colour score MLD* (1 = extremely pale to 6 = extremely dark); *Eye muscle depth at* P_2 (mm); *Drip loss* measured using a foreloin chop stored at 4°C for 48 hours and expressed as a percentage of the muscle weight; *Deep seated hair score:* a visual score of the amount of deep seated hair present on the skin (using a scale of 1 = clear, 2 = up to 25% coverage, 3 = up to 50% coverage, 4 = up to 75% coverage, 5 = over 75% coverage); *Marbling score* (MLD): a subjective score (0 = none to 3 = heavy marbling). A loin chop from each animal was analysed for moisture and intramuscular fat content. Moisture was determined by freeze drying to a constant weight for 36 hours. Intramuscular fat was estimated as the free fat content, determined by the petroleum spirit (40-60°C) method in accordance with BS 4401 (part 5). To measure shear force, loin joints were cooked in a vacuum pack by immersion in a water bath held at 90°C for 45 minutes to an internal joint temperature of approximately 78°C. Each joint was then plunged into cold running water for 15 minutes and subsequently 2 cm cores were measured for peak shear force. Loin steaks (20mm thickness) from each animal were grilled to an internal temperature of 63-64°C and evaluated for eating quality characteristics by trained sensory panel and rated on a scale 1-8 (increasing with intensity).

Table 1. Growth, carcass and meat quality measurements taken from all animals (n = 721).

Sex	Male	Female	*SE Mean*
Daily liveweight gain (g/day)	838	799	*3.43 ****
Lean tissue growth rate (g/day)	376	371	*1.76 NS*
Subcutaneous fat growth rate (g/day)	86.1	87.2	*0.48 NS*
Feed conversion ratio	2.39	2.55	*0.010 ****
Lean tissue feed conversion ratio	5.37	5.44	*0.026 NS*
Final liveweight (kg)	92.63	90.81	*28.53 ****
Side weight (kg)	32.55	33.51	*0.058 ****
Killing out proportions	0.749	0.766	*0.0011 ****
P_2 classification (mm)	11.49	11.74	*0.111 NS*
MLD depth (mm)	57.9	61.6	*0.25 ****
pH_{45} MLD	6.32	6.28	*0.020 NS*
MLD temp at 45 mins. (°C)	33.5	33.5	*0.126 NS*
pH ultimate MLD	5.81	5.80	*0.004 NS*
pH ultimate BF	5.82	5.81	*0.004 **
Japanese colour score LD	2.98	3.02	*0.027 NS*
Eel reflectance MLD	43.61	43.03	*0.287 NS*
Eel reflectance ham	39.38	38.61	*0.286 NS*
Drip loss (g/kg)	56.0	58.4	*1.16 NS*
Rind side blemish score	2.01	2.01	*0.008 NS*
Deep seated hair score	1.0	1.04	*0.013 NS*
Subjective fat firmness - ham	3.90	3.95	*0.026 NS*
Subjective fat firmness - mid-back	3.93	4.13	*0.028 ****
Fat penetrometer - mid-back	563	625	*6.00 ****
Marbling score MLD	0.68	0.70	*0.038 NS*
Moisture MLD (g/kg)	747	741	*0.45 ****
Intra muscular fat MLD (g/kg)	13.7	12.8	*0.37 NS*

Table 2. Cooking loss, shear force and sensory evaluation characteristics.

Sex	Male	Female	*SE Mean*
Number of animals	65	62	-
Shear force (Newtons)	33.2	33.7	*0.33 NS*
Cooking loss (g/kg)	275	274	*2.1 NS*
Assessment of lean (scale 1-8):			
Juiciness	4.97	4.93	*0.032 NS*
Tenderness	5.20	4.92	*0.039 ****
Pork flavour	4.57	4.55	*0.023 NS*
Abnormal flavour	2.05	2.00	*0.028 NS*
Overall acceptability	4.80	4.75	*0.032 NS*
Assessment of fat (scale 1-8):			
Pork odour	3.89	3.87	*0.027 NS*
Abnormal odour	2.10	2.00	*0.031 **
Boar odour	1.47	1.20	*0.025 ****

Results and discussion

Means for growth, carcass and meat quality measurements are shown in table 1. Entire males had higher daily liveweight gains and superior feed conversion ratios compared to females, however, lean tissue growth rates, subcutaneous fat growth rates and lean tissue feed conversion ratios were not significantly different between the sexes. Carcasses from entire males had reduced killing out proportions, similar P2 fat depths, but lower eye muscle depth compared to those from females. There were differences between the sexes for the ultimate pH of the Biceps femoris ($P<0.05$) and for the moisture content of the MLD ($P<0.001$), but the magnitude of these differences were small.

The only notable difference between the sexes regarding carcass quality, was the increased backfat firmness of female carcasses when assessed both by penetrometer and subjectively. This finding further confirms the criticism voiced by the industry regarding poorer fat handling qualities in entire males compared to females.

Marbling score and intra muscular fat (IMF) were similar for the sexes, however, percentage moisture was shown to be significantly higher in male animals.

Despite the widely held belief that eating quality tends to be inferior in meat from entire males, little scientific evidence exists to confirm this. In the present study, the only eating quality characteristic of the lean to differ between the sexes in the present study (Table 2) was that of tenderness, which was actually shown to be significantly superior in males (<0.001).

The results of this study confirm the findings of others (MLC, 1992), which have shown significantly higher abnormal odours and boar odours in the fat of entire males compared to females. However, differences such as those in the present study are unlikely to be detected by the consumer (Patterson et al, 1990). Cooking losses and shear force did not differ significantly between the sexes.

There was a significant sex x dietary treatment interaction for boar odour with the high energy low protein diet producing the highest levels of the biggest difference between the sexes for odour scores.

Conclusion

Lean tissue growth rates and lean tissue feed conversion ratios did not differ significantly between the sexes. The only notable difference between the sexes regarding carcass quality, was the increased backfat firmness of female carcasses. The tenderness of pork loin, assessed by trained sensory panel, was judged to be better from entires than females, however, there was no sex difference in overall acceptability. The fat from entires had a higher level of abnormal odour and boar odour particularly when fed a high energy low protein diet.

References

Blanchard P J, Chadwick J P, Warkup C C, Ellis M and Deans G (1995). *Animal Science* 60, 512.

Engel B and Walstra P (1991). *Animal Production* 53, 353-359.

MLC (1992). Meat and Livestock Commission, Second Stotfold Pig Unit Trial Results, MLC, Milton Keynes, UK.

Patterson R L S, Elks P K, Lowe D B and Kempster A J (1990). *Animal Production* 50, 551.