Influence of breed and slaughter weight on the prevalence of boar taint in entire male pigs

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Abstract

Entire males from the three most common Belgian pig breeds – Piétrain (P), Large White (LW) and Belgian Landrace Stress Negative (BN) - were slaughtered at 50, 70, 90 or 110 kg live weight. Boar taint detection was performed by four different methodologies: hot iron (neckfat), consumer panels (meat), expert panels (fat and meat) and laboratory analysis (fat). Skatole levels in fat were significantly higher for LW than P boars. P boars showed a tendency for higher indole levels. Androstenone levels depended on slaughter weight (higher levels for the boars of 90 and 110 kg compared to 50 kg) and tended to differ between breeds (highest for LW and the lowest for P). Analogous results were found for the hot iron method, with a significant increase of boar taint with higher weights and more boar taint among LW versus P boars. The expert panel also revealed more androstenone odour in fat of boars slaughtered at 90 kg compared to those slaughtered at 50 kg and in meat of the boars slaughtered at 110 kg compared to 50 kg. Consumers did not detect differences between breeds or weights. Assuming that our experimental set-up of consumer panels was inadequate to produce reliable estimates of boar taint, these results indicate that boar taint prevalence among entire male pigs can be reduced by (substantially) lowering slaughter weight and by using P instead of LW breed.

Introduction

Castration of male pigs is practised in order to avoid the occurrence of boar taint, an unpleasant odour present in some boars. Skatole and androstenone are judged to be the primary responsible compounds causing this boar taint. Skatole (faecal-like odour) is a by-product of the metabolism of the amino acid L-tryptophan in the large intestine of the pig. Androstenone (urine-like odour) is a steroid produced in the testis and serves as a pheromone after transportation to the submaxillary salivary gland and binding to a specific binding protein pheromaxein. Skatole and especially androstenone heritability estimates are considerably high and breed differences have been described. Moreover, a strong correlation between androstenone and live weight has been established (Zamaratskaia 2004). So, prevalence of boar taint in entire males might be reduced by adaptation of breed and slaughter weight. Therefore, this study focuses on the influence of breed and slaughter weight on the prevalence of boar taint in the most common Belgian breeds: Piétrain (P), Large White (LW) and Belgian Landrace Stress Negative (BN).

Materials and methods

Four replicates of 4 pens with 6 boars per breed (P, LW, BN) were raised. Per replicate, penmates were slaughtered at an average live weight of 50, 70, 90 or 110 kg. Loin samples with backfat layer (30 cm around the fifth rib) were collected 24 hours after slaughtering. Boar taint detection was performed by four different methodologies. At the abattoir, boar taint was scored with the hot iron method on a scale from 1 (neutral) to 4 (bad) by heating the neckfat with a soldering iron. Consumer panels were performed for the meat samples of the groups of 90 and 110 kg slaughter weight. Each sample was scored by 6 consumers on a scale from 1 (good) to 5 (bad) for tastiness, and on a scale from 1 (good) to 6 (bad) for odour and flavour. Experts were trained to detect androstenone and skatole. They scored fat samples for odour and meat samples for odour and flavour. Each sample was scored by 6 experts on a scale from 1 (neutral) to 7 (bad) for odour/flavour in general, androstenone, skatole and other disturbing components. Meat samples for expert and consumer panels were prepared using a standardised method: grilled (1800 Watt) during 3 minutes. The fat samples were heated in the microwave oven following a standard procedure. Indole, skatole and androstenone concentrations in fat were analysed using LC-MS^n as described by Verheyden *et al.* (2007). According to this method, only 180 androstenone values could be determined above the limit of quantification. This might be due to problems during extraction of this steroid hormone.

Mean levels or scores per pig were compared for the different detection parameters with ANOVA with breed, weight and their interaction as fixed factor, Tukey was used as a post hoc test (Statistica 8). Correlations between boar taint and age and weight, were also calculated ($p<0.05$).

Results and discussion

Laboratory determination of skatole levels in fat were significantly higher for the LW breed (0.06±0.10 ppm) compared to the P breed (0.03±0.03 ppm) (Table 1). Overall, only a low percentage (4 %) of animals exceeded the cut-off level of 0.20 ppm. A tendency for breed differences were found also for laboratory analyses of indole levels (with P having the highest concentration in fat) and androstenone levels. The latter tended to be highest for LW (0.29±0.39 ppm) and lowest for P (0.17±0.23 ppm). Androstenone levels were weight dependent, with higher levels for the boars slaughtered at 90 and 110 kg (0.30±0.42 ppm) compared to 50 kg (0.12±0.18 ppm). Using the hot iron method, a significant interaction was found between breed and weight: significantly more boar taint was detected for LW110 compared to LW50, LW90, BN50, BN70, P50, P70, P90 and P110. The hot iron method also indicated a weight dependency and more boar taint was found for LW compared to P. Significantly more problems were detected by the experts for androstenone odour in meat and fat of boars slaughtered at respectively 110 and 90 kg compared to 50 kg. The expert panel did not reveal significant breed differences for boar taint, but there was a tendency for LW to have a stronger androstenone odour in fat than P. Consumers did not detect differences between breeds or weights. Age and weight at slaughter were only weakly correlated with some of the boar taint detection methods, which was highest for the hot iron method (r_{age}= 0.16 and r_{weight}=0.28). Correlations varied between breeds, and were strongest for LW (e.g. hot iron: r_{age}=0.35 and r_{weight}=0.37). For laboratory analyses of boar taint compounds, overall and breed-specific correlations were found (indole: r_{age}=0.13, skatole: r_{age}=-0.17, androstenone: r_{weight}=0.27).

Androstenone levels has been found to be dependent of live weight and sexual development, previously (Babol *et al*., 1996). The results of the laboratory analysis and expert panel (androstenone odour) of the present study confirm these associations. The relation between skatole and live weight is less clear and varies in literature between slightly negative, none to positive. Zamaratskaia (2004) found high skatole plasma levels at young age, followed by a decrease from week 10 to 12 and again an increase at week 18, but this patterns was breed dependent. No weight effects were found for skatole according to laboratory analyses and expert panels and the correlation between skatole and age was negative. Higher androstenone levels are described for P compared to Belgian Landrace (Xue *et al*., 1996) and lower skatole levels for P compared to LWxP or synthetic crossbred sires (Bonneau *et al*., 1992). Similar results were found in this study for skatole, but not for androstenone levels.

Conclusions

The results of our study indicate that boar taint was less present in P than in LW as assessed by the hot iron method, laboratory analyses of skatole (trend), androstenone and the experts for androstenone odour in fat (trend). Increase in boar taint prevalence with higher slaughter weights was found by the hot iron method, the laboratory analyses of androstenone in fat and by the experts for odour of androstenone in fat and meat.

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Table 1. Scores, concentrations and percentages of deviation for the parameters of the boar taint detection methods

Breed	**BN**				**LW**				**P**				**p-value**		
Weight	**50**	**70**	**90**	**110**	**50**	**70**	**90**	**110**	**50**	**70**	**90**	**110**	**Breed**	**Weight**	**BreedxWeight**
n	24	24	22	24	24	23	24	24	24	22	23	21			
Lab (ppm)															
Indole	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.04	0.04	0.091	0.433	0.161
%>0.10ppm	*8*	*0*	*0*	*0*	*0*	*0*	*0*	*5*	*0*	*5*	*9*	*15*			
Skatole	0.08	0.04	0.05	0.05	0.09	0.07	0.04	0.05	0.03	0.03	0.03	0.03	**0.005**	0.213	0.283
%>0.20ppm	*9*	*0*	*5*	*4*	*13*	*13*	*0*	*4*	*0*	*0*	*0*	*0*			
Androstenone	0.06	0.13	0.42	0.28	0.21	0.27	0.21	0.48	0.06	0.13	0.32	0.16	0.085	***0.010***	0.086
%>0.50ppm	*0*	*0*	*25*	*14*	*18*	*23*	*18*	*29*	*0*	*9*	*21*	*6*			
Hot iron	1.2^{b}	1.1^{b}	1.5^{ab}	1.4^{ab}	1.1^{b}	1.4^{ab}	1.2^{b}	1.9^{a}	1.0^{b}	1.2^{b}	1.3^{b}	1.1^{b}	***0.007***	***<0.001***	***<0.001***
*%>1.5**	*17*	*8*	*36*	*29*	*4*	*30*	*21*	*56*	*0*	*18*	*22*	*5*			
Experts: fat															
General	1.7	1.9	2.0	2.0	1.9	2.0	1.8	2.2	1.9	1.8	2.0	1.7	0.332	0.513	0.061
%≥3	*0*	*17*	*5*	*8*	*8*	*9*	*0*	*13*	*0*	*5*	*9*	*0*			
Androstenone	1.4	1.7	1.7	1.7	1.6	1.7	1.6	1.8	1.4	1.6	1.7	1.4	0.058	***0.033***	0.385
%≥3	*0*	*4*	*5*	*0*	*4*	*4*	*0*	*0*	*0*	*0*	*0*	*0*			
Skatole	1.3	1.4	1.3	1.4	1.3	1.4	1.3	1.5	1.4	1.4	1.3	1.3	0.774	0.587	0.533
%≥3	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*4*	*0*			
Experts: meat															
Odour general	1.5	1.5	1.4	1.6	1.4	1.6	1.3	1.8	1.4	1.7	1.6	1.4	0.933	0.111	0.100
%≥3	*0*	*0*	*0*	*0*	*0*	*9*	*0*	*8*	*0*	*0*	*4*	*5*			
Odour androstenone	1.4	1.3	1.3	1.5	1.3	1.4	1.2	1.6	1.3	1.4	1.4	1.3	0.836	***0.044***	0.097
%≥3	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*4*	*0*	*0*	*4*	*0*			
Odour skatole	1.1	1.1	1.1	1.1	1.1	1.2	1.1	1.2	1.1	1.2	1.3	1.1	0.277	0.775	0.070
%≥3	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*4*	*0*	*0*	*4*	*0*			
Taste general	1.5	1.4	1.3	1.4	1.4	1.5	1.4	1.7	1.3	1.5	1.7	1.3	0.380	0.759	***0.013***
%≥3	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*8*	*0*	*0*	*4*	*0*			
Taste androstenone	1.3	1.2	1.2	1.3	1.2	1.3	1.2	1.5	1.2	1.4	1.5	1.2	0.242	0.281	***0.019***
%≥3	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*4*	*0*	*0*	*4*	*0*			
Taste skatole	1.2	1.1	1.1	1.1	1.2	1.2	1.1	1.2	1.1	1.1	1.3	1.1	0.436	0.720	0.146
%≥3	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*4*	*0*			
Consumers															
Odour			2.7	2.8			2.7	2.7			2.6	2.6	0.128	0.596	0.956
%>3			*23*	*29*			*17*	*17*			*17*	*14*			
Flavour			2.9	2.9			2.7	2.7			2.8	2.8	0.179	0.930	0.186
%>3			*41*	*42*			*17*	*21*			*22*	*24*			
Tastiness			2.9	2.9			2.7	2.7			2.7	2.8	0.128	0.596	0.956
%>3			*41*	*50*			*17*	*21*			*22*	*24*			

** Cut-off values for hot iron method, experts and consumers were taken at the corresponding value of a neutral or acceptable evaluation of the sample*