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On farm intervention studies on reduction of boar taint prevalence: Feeding strategies, presence of gilts and time in lairage

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ABSTRACT

One of the challenges in the production of entire male pigs is the occurrence of boar taint. We separately tested the effect of 3 management strategies to reduce boar taint on respectively 2, 3, and 6 Flemish pig farms: 1) adapted feeding strategies, 2) presence of gilts in the compartment, and 3) varying lairage duration at the slaughterhouse.

A commercialized feed concept resulted in a significant reduction of olfactory boar taint prevalence when fed for 2 weeks (T2W) compared to control (T-CON) ($P = 0.030$). For T2W and when fed for 3 weeks (T3W), androstenone (AND) ($P = 0.002$ for T2W, $P = 0.029$ for T3W) and skatole (SKA) ($P < 0.001$ for T2W and T3W) were significantly reduced compared to T-CON. Olfactory boar taint prevalence was significantly reduced when feeding 5% dried chicory roots (FI5%) ($P = 0.032$), but not for 3% dried chicory roots (FI3%) ($P = 0.958$). SKA concentration was significantly lower when feeding FI5% ($P < 0.001$) and when feeding FI3% ($P = 0.034$). Rearing entire male pigs separately from gilts and increasing lairage duration from < 1 h to > 3 h did not significantly affect boar taint.

1. Introduction

EU consumers are becoming increasingly concerned about the practice of surgical castration of male piglets. One alternative - raising entire boars - is accompanied by the risk of boar taint in the fat and meat. Boar taint is caused by the compounds androstenone (AND), skatole (SKA), and to a lesser extent indole (IND). AND is produced in the testes while SKA and IND are produced in the gut by micro-organisms (Claus et al., 1994; Rius and García-Regueiro, 2001). Research performed in Belgium has reported a boar taint prevalence of approximately 5% of the carcasses of entire male pigs (Aluwé et al., 2014). Several management strategies aimed at reduction of boar taint have been reported. Strategies to reduce AND levels include genetic selection (Haberland, 2013) and lowering slaughter weight (Walstra et al., 1999).

Feeding measures, in particular feeding of inulin or chicory roots, have been proposed to reduce SKA levels in back fat (Aluwé et al., 2011; Kjos et al., 2010; Rasmussen et al., 2012). These feed constituents are considered as an energy source for bacteria in the large intestine, allowing the deposit of nitrogen as bacterial protein instead of fermenting the protein, which would result in the production of skatole, indole and other metabolites (Jensen and Hansen, 2007). Dried chicory roots have been found to increase the expression and activity of the cytochrome P450 system, which is responsible for the metabolism of skatole (Rasmussen et al., 2011). It has been suggested that dried chicory roots can also reduce accumulation of AND in fat by induction of 3β-hydroxysteroid dehydrogenase (3β-HSD) (Rasmussen et al., 2012).

Several other management strategies have been associated with boar taint levels, although the biological mechanisms are still unclear and the results are not consistent. These strategies include the presence/absence of gilts in the fattening stable due to its effect on puberty, where it is hypothesized that absence of gilts reduces boar taint compounds (Andersson et al., 1999; Fàbrega et al., 2011; Patterson and Lightfoot, 1984; Zamaratskaia et al., 2005). Pre-slaughter management such as transport time and pre-unloading time (after arrival and prior to unloading) at the slaughterhouse has been suggested as influencing factor, where longer times increase boar taint compound concentrations. At slaughter, increased skin lesions have been linked with higher boar taint levels; it has been proposed that stressful conditions during

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transport can increase boar taint (Wesoly et al., 2014).

In previous research, we have studied the association between animal and farm characteristics and the prevalence of boar taint (Heyrman et al., 2017). Because association studies do not shed light on causality, we set up intervention studies in commercial settings to get more insight. Based on the previously observed associations, the scientific literature described above, and the applicability in farm practice, we selected and separately tested the effect of 3 management strategies on boar taint prevalence and concentrations of AND, SKA, and IND on Flemish (Belgian) pig farms, namely: 1) adapted feeding (3 trials), 2) presence of gilts in the compartment, and 3) varying lairage duration at the slaughterhouse. In these studies, we also evaluated carcass weight, lean meat percentage and skin lesions because these are easily measured at slaughter and can be associated with boar taint (Walstra et al., 1999; Wesoly et al., 2014).

2. Materials & methods

2.1. Tested strategies and experimental design

Three strategies to reduce boar taint were tested on commercial farms, in one or more age groups or slaughter batches (Table 1), by evaluating boar taint prevalence using olfactory analysis and chemical analysis of the boar taint compounds.

For the feed strategy, 3 trials were performed. In a first trial, the effect of feeding a commercialized feed concept for 2 or 3 weeks before slaughter was compared to a control diet. In a second feed trial, the effect of feeding 5% chicory roots during 2 weeks before slaughter was compared to a control diet. A third trial evaluated the effect of feeding 3% chicory roots during 2 weeks before slaughter as compared to a control diet. As a second strategy, the effect of the presence of gilts in a compartment, was evaluated compared to absence of gilts. As third strategy, we tested the effect of < 1 h versus > 3 h of lairage.

The experiments were done on a total of 11 farms and were divided over 1 or more slaughter batches per treatment group (Table 1). For the feed trials and presence of gilts experiment, farms were selected based on their willingness to participate and their suitability in terms of group size and housing system. For the experiment on time of lairage, we included slaughter batches that arrived at the slaughterhouse on convenient days. As a result, farm related information such as age of the animals is not known for the experiment on time of lairage. In the feed and presence of gilts experiments, time of lairage were comparable for each treatment group and animals were penned in treatment groups during transport.

2.1.1. Feed trials

In feed trial 1, an commercial feed concept was evaluated (TAINTSTOP, Dumoulin, Belgium) for the reduction of boar taint on farm 1. A patent has been filed for this concept (EP17207866.9), and exact feed formulation is not available. It has 3 elements: a mix of different fibrous materials, specific feed additives and some rules of feed formulation in relation to the supply of fiber and protein. Three treatment groups were compared. The feed concept fed during the last 3 weeks before slaughter (T3W), the feed concept during the last 2 weeks (T2W), or the standard diet of that farm (T-CON). The control diet was formulated and produced by the commercial supplier of the pig farmer (*Nollet voeders*, Belgium), the composition of their feed is subject to company secret, hence we cannot supply it in full, a feed sample has been analyzed together with samples from the other treatments from all feed trials. The feed concept was produced by Dumoulin (Belgium) and delivered in 25 kg packaging. All pens, with on average 13 pigs, were randomly assigned to the treatment groups and were hence dispersed over the compartment. All pigs were fed ad-libitum in both treatment groups as well as in the control group.

In feed trial 2 (farm 2), 5% dried and crushed chicory roots (Fibrofos 60, containing at least 60% inulin, Socode, Warcoing, Belgium) were added to the feed during the 2 weeks before slaughter (FI5%) was compared with a control diet (FI-CON1). Diets only differed in the addition of chicory roots (Table 2). In feed trial 3 (also on farm 2), the addition of 3% dried and crushed chicory roots in the finishing diet during 2 weeks before slaughter (FI3%) was compared with a control diet (FI-CON2).

In feed trials 2 and 3, animals were housed in the same compartment and diets were divided over the compartment, with one random side of the hallway receiving the treatment diet and the other side receiving the control diet. Animals were housed on average with 11 pigs per pen. All feeds were produced by Cibus, Belgium who reported the feed composition, the feeds were also analyzed at ILVO. All pigs were

Table 1
Description of experiments per strategy, with information on breed, number of slaughter batches, slaughter age per batch and the total number of animals per treatment group and per slaughter batch.

Experiment	Farm-identification	Breed (sow x boar)	Number of batches	Age (weeks) per batch (B)	Number of animals/treatment group[a]/batch
Feed trials					
Trial 1	1	Danbred x Piétrain	1	27	T-CON = 136, T3W = 112, T2W = 107
Trial 2	2	Topigs x Piétrain	2	Batch 1: 29	FI-CON1 = 65, FI5% = 66
				Batch 2: 29	FI-CON1 = 83, FI5% = 86
Trial 3	2	Topigs x Piétrain	1	31	FI-CON2 = 92, FI3% = 78
Presence of gilts					
	3	Danbred x Piétrain	1	26	GP = 102, NGP = 104
	4	Hypor x Piétrain	1	30	GP = 101, NGP = 101
	5	Topigs x Piétrain	4	B1: 29	GP = 0, NGP = 133
				B2: 29	GP = 131, NGP = 63
				B3: 31	GP = 130, NGP = 65
				B4: 32	GP = 23, NGP = 126
Time in lairage[b]				1	
	6	Danbred x Piétrain	1		< 1 h = 110, > 3 h = 103
	7	Topigs x Piétrain	1		< 1 h = 105, > 3 h = 79
	8	French hybrid x Piétrain	1		< 1 h = 140, > 3 h = 176
	9	Topigs x Piétrain	1		< 1 h = 79, > 3 h = 136
	10	Topigs x Piétrain	1		< 1 h = 68, > 3 h = 106
	11	Topigs x Piétrain	1		< 1 h = 87, > 3 h = 102

[a] Feed: Trial 1: T-CON: control diet; T3W: feed concept 3 weeks before slaughter; T2W: feed concept 2 weeks before slaughter. Trial 2: FI-CON1: control diet trial 2; FI5%: 5% inclusion of dried chicory roots; FI-CON2: control diet trial 3, FI3%: 3% inclusion of dried chicory roots; presence of gilts: GP: Gilts present in compartment, NGP: no gilts present in compartment; time in lairage: < 1 h: no longer than 1 h spent in lairage, > 3 h: longer than 3 h spent in lairage.

[b] Age of the entire male pigs is unknown.