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The behaviour of male fattening pigs following either surgical castration or vaccination with a GnRF vaccine

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ABSTRACT

Vaccination of male fattening pigs with a gonadotropin releasing factor (GnRF) vaccine is regarded as a possible solution to solve the welfare problem associated with surgical castration, which causes pain and stress even when performed under local or general anaesthesia. The objective of the present study was to compare the behaviour of male fattening pigs either surgically castrated without anaesthesia (T1) or vaccinated twice with a GnRF vaccine (T2). Data collection took place in a commercial German fattening unit. Each treatment comprised 8 groups of 12 pigs, housed in fattening pens with partially slatted floor and liquid feed provided three times a day. Data on postures were scored from 24-h videos recorded in every week of the fattening period (16 weeks) using scan sampling with 5 min intervals. Social behaviour was analysed in weeks 2, 4, 6, 8, 10, 12, 14, 15 and 16 by continuous behaviour recording of focus animals in four blocks of 2 h phased evenly during the day. Overall, during the whole fattening period, vaccinates (T2) were more active than surgical castrates (T1), indicated by a higher proportion of pigs standing (T1: 9.3%; T2: 10.74%; $P < 0.023$). T2 animals showed a significant decrease in standing and an increase of sitting and lying after the second vaccination of Improvac. No significant effects of treatment on the total number of agonistic interactions ($P = 0.064$) and on biting and fighting ($P = 0.151$) were found. In T2 the prevalence of aggressive behaviours decreased after the second vaccination ($P < 0.001$), which was not found in T1 during the same period. T2 animals showed a higher level of mounting behaviour compared with T1 animals, but on a very low level. Treatment had no effect on the prevalence of play behaviour and manipulating of pen mates. It is concluded that housing of male pigs vaccinated against GnRF in single sex groups of 12 individuals does not increase behavioural problems in the fattening period compared with surgically castrated males.

1. Introduction

Castration of male fattening pigs is a common procedure to prevent boar taint in pork. In most EU countries, pigs are castrated surgically within the first week of life without anaesthesia and post-operative analgesia. Although this procedure is legally allowed in the EU (EC, 2001) there is growing scientific and public concern from a welfare point of view. A number of studies have shown that surgical castration causes stress, acute and chronic pain, wound infections and a depression in weight gain (Prunier et al., 2006).

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In order to relieve pain, surgical castration may be performed under local or general anaesthesia. These methods have been investigated in several studies (EFSA, 2004; PIGCAS, 2009; von Borell et al., 2009). Alternatively to surgical castration, testicular function can be inhibited by down-regulation of the hypothalamic–pituitary–gonadal axis. Active immunisation of male pigs against GnRF reduces plasma gonadotropin and androgen levels and either inhibits the development or causes the regression of testicular parenchyma and the secondary male sex organs. Several studies have shown that vaccination against GnRF (also known as immunocastration) is effective in the prevention of boar taint in male fattening pigs (Dunshea et al., 2001; Jaros et al., 2005). The animals have to be vaccinated twice. The second dose, which is expected to elicit an immunological reaction with high antibody titre response against GnRF should be given no later than 4 weeks prior to slaughter, to allow any boar taint substances already present to be metabolised and eliminated. A commercial GnRF vaccine (Improvac^{TM}, Pfizer Animal Health) is registered for use in pig industries in the EU, Switzerland, Russia and in countries outside Europe such as Australia, Mexico and Brazil.

Much is known about the impact of GnRF vaccination on feed efficiency, growth rate, boar taint and pork quality (EFSA, 2004; PIGCAS, 2009; Mackinnon and Pearce, 2007). However, welfare aspects of immunisation of young male pigs against GnRF have been poorly investigated (Prunier et al., 2006). Only a few studies have focused on the behavioural consequences. It has been found that up to the second administration the GnRF vaccinated pigs behaved like entire males. Vaccinates were more active and social behaviour, including aggression and mounting, were more frequent compared to pigs castrated surgically (Cronin et al., 2003). Rydhmer et al. (2006) concluded that the rearing of entire male pigs may cause welfare problems (lameness or injured legs or feet), given their higher levels of aggression and sexual behaviour. The behaviour of effectively immunised male pigs (after the second vaccination) was similar to that of surgically castrated ones. Immunocastrates showed less social, manipulating and aggressive behaviour than entire male pigs (Cronin et al., 2003; Velarde et al., 2008) and remained sexually inactive in the mating test (Zamaratskaia et al., 2007).

Due to the lack of sufficient scientific evidence, the final report of PIGCAS (2009) recommended further research on management of vaccinated pigs and its consequences. The objective of our study was to analyse the behaviour of Improvac vaccinated and surgically castrated male pigs from the beginning to the end of the fattening period under commercial German production conditions. We hypothesised that vaccinates are more active than surgically castrated pigs both in general and in social behaviour prior to the second administration of Improvac (i.e., before effective immunocastration). However, there should be no difference after the second administration.

2. Materials and methods

2.1. Animals and housing

A total of 230 crossbred male piglets (EUROC Hybrid × Pietrain) from 55 litters (one to seven male piglets per litter) were initially enrolled in the study. As assessed by a veterinarian, all piglets were in good general health. Piglets were randomly selected within litters to avoid litter effects and assigned to two treatment groups ($n = 115$ in each group) at the age of 5.07 ± 0.80 days (range 3–7 days; group T1) and 5.07 ± 0.87 days (range 2–6 days; group T2). The same day, piglets were ear-tagged with three different tags for unambiguous identification: one tag with the number coding for the farm, and two red (T1) or green (T2) tags, one on each ear, for identifying group and animal ID. Lactating sows were housed in farrowing crates with partially slatted floors and red-light heat lamps in the piglet area. Piglets had ad libitum access to water, and between day 7 and weaning, were fed a commercially available starter feed with 15.5 MJ metabolic energy (ME) per kg dry matter (DM) and 1.25% lysine per kg DM (Denkapig Mini Start; Denkavit Futtermittel GmbH, Warendorf, Germany). A total of six piglets died during lactation (two in T1 and four in T2), and 113 and 111 piglets in T1 and T2, respectively, were weaned and moved to the nursery at the age of 27.1 ± 0.80 days.

In the nursery, all pigs were housed in six pens in one room. Subgroups of each treatment (i.e., 52, 31, and 30; and 50, 31, and 30 pigs per pen for T1 and T2, respectively) were randomly assigned to the nursery pens. Pens had fully slatted floors and multi-space feeders for dry feed. On the day of relocation to the nursery, pigs were continued on piglet starter feed and then switched to a phase 1 nursery diet containing 14.6 MJ ME and 1.45% lysine per kg DM (Optistart; Denkavit Futtermittel GmbH) given ad libitum. From day 15 until the end of nursery period at 10 weeks of age, pigs were fed ad libitum a phase 2 nursery diet containing 13.6 MJ ME and 1.25% lysine per kg DM (FA I-Super; Denkavit Futtermittel GmbH). During the nursery phase, two T1 and three T2 pigs died or were euthanized. A total of 111 and 108 pigs in T1 and T2, respectively, were moved into the grower-finisher unit at the age of 10 weeks. Of these pigs, 96 per group were randomly selected for further consideration.

The grower-finisher unit had a total of 36 pens, with 18 pens on each side separated by an aisle. The room was air conditioned in order to maintain an ambient temperature of between 18 and 22 °C. Pens measured 2.0 m × 5.2 m, housing 12 pigs with a space allowance of 0.87 m^2 per pig. Floors were partially slatted with a solid area (2.0 m × 0.5 m) arranged opposite to the gangway. The wall separating alternate pens accommodated a 4.5-m long trough, split longitudinally to feed animals of adjacent pens. The animals had permanent access to water (one nipple drinker per pen). All 192 pigs of T1 and T2 were confined in a total of 16 pens on one side of the unit. Pens were randomly assigned to treatment groups, and then pigs in a nursery group were randomly assigned to these pens. Animals from different nursery groups were not mixed in grower-finisher pens. Twelve of 15 remaining T1 pigs and the 12 remaining T2 pigs were housed in the

remaining two pens. Pens on the opposite side of the aisle were filled with non-experimental pigs, including the last three animals from T1. Experimental and non-experimental pigs were never mixed and did not share the same feeders. Natural light was provided equally to all pigs. Pigs were fed three times a day (7:30 am, 1:00 pm and 4:00 pm). Between days 1 and 39 in the finisher unit, pigs were fed a liquid diet containing 13.56 MJ ME and 1.12% lysine per kg DM, followed by a diet that contained 13.37 MJ ME and 0.95% lysine per kg DM. Each pen was equipped with an iron chain providing some stimulation and exercise. During the growing-finishing phase, five pigs from T1 and five from T2 died or were euthanized. A sixth pig in T2 was detected as being mistakenly surgically castrated and was consequently withdrawn from the study.

2.2. Treatment

Immediately after being randomly allocated to the group (i.e., at the age of 5.07 ± 0.80 days), T1 piglets were surgically castrated without anaesthesia by a skilled farm employee according to an on-farm standard operating procedure (piglets were restrained by another employee, the scrotal surface was disinfected, and the testes were removed using a disposable sterile scalpel and an emasculator within 20–30 s). The T2 piglets were not surgically castrated, but were later immunised using Improvac™ (Pfizer Ltd.), an injectable vaccine containing modified synthetic GnRF coupled to a carrier protein in an aqueous adjuvant. Two doses of vaccine were administered, with the first given at 10 weeks of age, immediately after relocation into the grower-finisher unit. The second injection was given at 21 weeks of age, 4–5 weeks prior to slaughter. For each injection, 2 ml of Improvac were administered subcutaneously in the neck immediately behind the base of the ear using a disposable 2-ml syringe and an 18-gauge needle.

The growth performance of the experimental animals was investigated by Schmoll et al. (2009). At the beginning of the fattening period treatments differed significantly ($P = 0.014$) in body weight (LS means T1: 27.6 kg, T2: 29.0 kg). Five pigs of T1 and five pigs of T2 died or were euthanized during the fattening period. Pigs were slaughtered at 25 or 26 weeks of age. Carcass weight was significantly higher ($P = 0.025$) in T2 animals (LS means; T1: 94.81 kg; T2: 97.67 kg).

2.3. Behaviour recording and data analysis

From the beginning to the end of the fattening period (weeks 1–16) the behaviour of the animals was videotaped once a week for 24 h. Behavioural observations were conducted using digital video recording ('MSH Video System' consisting of a video server, the MSH Video software and 8 cameras, each camera observing two neighbouring pens). Night time video recording was assisted by a minimum of artificial light attached on the roof between two neighbouring pens. Data collection took place in the period from 17 October, 2007 to 30 January, 2008. For data storage a Tandberg DLT VS160 Tape Drive was used. Behavioural observations were focused on general activity (postures) and on social behaviour of T1 and T2 animals.

In order to analyse the development of the treatment groups the fattening period was divided in four phases: phase I (fattening weeks 1–4; pigs 10–13 weeks old), phase II (weeks 5–8; pigs 14–17 weeks old), phase III (weeks 9–12; pigs 18–21 weeks old) and phase IV (weeks 13–16; pigs 22–25 weeks old). In fattening phases I–III (before second vaccination of Improvac) surgical castrates (T1) are compared to entire males (T2). In fattening phase IV (after the second vaccination) surgical castrates (T1) are compared to fully vaccinated males (T2).

2.3.1. General activity

Data on postures of the animals were analysed by one observer from 24-h videos recorded in each week of the fattening period (1–16). In each experimental pen the number of pigs standing, sitting and lying was scored within the first 30 min of each hour using scan sampling at 5 min intervals. The database for statistical analysis of general activity (postures) included 36,864 scans. The statistical unit was the pen. Prior to statistical analysis the data were transformed in relative numbers (proportion of pigs within a pen showing a certain posture; mean of the day).

These data were analysed with SAS, Version 9.1 (SAS Institute, Cary, NC, USA). Treatment effects on general activity were evaluated using linear mixed models (procedure MIXED) with repeated measurement design (pen as repeated subject) and a compound symmetry covariance structure (type = cs). The model included treatment (T1 and T2), fattening phase and the interaction between treatment and fattening phase as fixed effects. The visual evaluation of the residual plots for normal distribution was positive for all parameters investigated. Effects with more than two levels were corrected for multiple testing with Tukey test. The level of significance was set at $P = 0.05$.

2.3.2. Social behaviour

Social behaviour was analysed from 24-h videos of fattening weeks 2, 4, 6, 8, 10, 12, 14, 15 and 16 by three trained observers. In each of the 16 experimental pens four pigs were randomly chosen as focus animals and marked individually. On each observation day behaviour was observed for 8 h allocated in four blocks of 2 h (A: 00:30–02:30, B: 07:30–09:30, C: 12:30–14:30 and D: 16:45–18:45). Within these time blocks the focus animals were continuously observed one by one for 2 min rotationally (4× 30 min observation time per pig and week). The number of displacing, head knocking, biting, fighting, quarrelling at fence, playing, manipulating of pen mates (on belly, tail, ear or other body regions), mounting and mounting attempt were recorded. Except for displacing, fighting and playing the interactions were registered both when the focus animal was the actor and the receiver. Table 1 gives a list of definitions of the social behaviours registered.

Data preparation and statistical analysis were performed using the statistical package SAS 9.1. The analysis

Table 1
List of the social behavioural patterns registered with definitions.

Behaviour	Definition
Displacing	Physical contact at shoulder, side, flank or rump, actor forces receiver to make way
Head knocking	Physical contact where actor hits receiver with its head (mouth closed); the behaviour is registered both if focal animal is actor (active) and receiver (passive)
Biting	Thrust with open mouth (active and passive)
Fighting	Interaction of ≥5 s including different agonistic behavioural patterns such as head knocking, parallel pressing, levering, biting, chasing
Quarrelling at fence	Interaction (pushing, knocking, biting, tracing) of pigs in adjacent pens at the fence
Agonistic interaction	Sum of single agonistic interactions listed above
Mounting	The actor climbs onto a group mate and rides (≥2 s) (active and passive)
Mounting attempt	Unsuccessful attempt to mount (<2 s); (active and passive)
Playing	Hop, scamper, pivot, paw, flop and head toss while running or standing, alone or with pen mates
Manipulating of pen mate	Tail biting, ear biting and belly nosing (active and passive)

of the social behaviour was based on numbers of interactions per observation block and pen (T1 = 262, T2 = 287). The highly differentiated ethogram resulted in low frequencies of single agonistic measures and thus were combined and analysed as 'agonistic interactions', 'displacing and head knocking' and 'biting and fighting'. Furthermore 'mounting' and 'mounting attempts' were subsumed to 'mounting behaviour'.

Frequencies of behaviours did not show normal distribution of the residuals. Thus data were log transformed and analysed using the GENMOD procedure with repeated measurement design (repeated subject: pen). Least squares means of the number of behaviours performed by the focus animals within one observation block were compared. The GEE-model (generalized estimating equations) included the fixed effects of treatment (T1, T2), fattening phase (I–IV), observation block (A–D) and observer as well as the interactions of treatment with fattening phase and observation block. A negative binomial distribution (dist = nb) and a log-link function (link = log) were modelled and a compound symmetry covariance structure was fitted. With the MULTTEST procedure multiple comparisons were performed. For post hoc paired comparisons the Bonferroni–Holm test was used. The level of significance was set at $P = 0.05$.

3. Results

3.1. General activity

Analyses of postures showed low activity in both treatment groups. The proportion of pigs which were standing ranged from 7.2 to 14.2% per pen (Fig. 1). Both T1 and T2 groups showed peaks (weeks 1, 4 and 7) and drops (weeks 3 and 6) in 'standing' in the course of the fattening period. Apart from the first week the highest level of activity was found in week 11 followed by a decrease to the end of the observation period at week 16 (Fig. 1). Pigs spent most time in a lying posture indicated by a high proportion of pigs lying (LS mean: 82.9–90.3%). Sitting ranged from 1.9 to 3.7%.

Based on the data of the entire fattening period the analysis of variance identified significant effects of treatment and fattening phase on the postures of the animals. Vaccinates (T2) were more active than surgically castrates (T1) indicated by a higher proportion of pigs standing ($P = 0.023$). The proportion of lying pigs was higher in T1 compared to T2 ($P = 0.027$). There was no difference between treatments in sitting. However, the interaction between treatment and fattening phase had no effect on postures (standing: $P = 0.262$) of the animals (Table 2).

The model calculated on the database of the period after the second vaccination of T2 (fattening phase IV: weeks 13–15) found no difference between treatment groups on general activity patterns. However, regarding the parameter standing the interaction of treatment and week was found significant ($P = 0.012$). Only T2 animals showed a significant decrease in standing and an increase of sitting and lying from week 13 to week 14 (Table 2).

3.2. Social behaviour

3.2.1. Aggressive behaviour

In both treatments the number of agonistic interactions was highest at the beginning of the fattening period (Fig. 2). A decrease in fattening phase II was followed by a slight increase in phase III. At the end of the observation period (IV) the level of aggression decreased again.

The model calculated for the entire fattening period found no significant effect of the treatment on the total

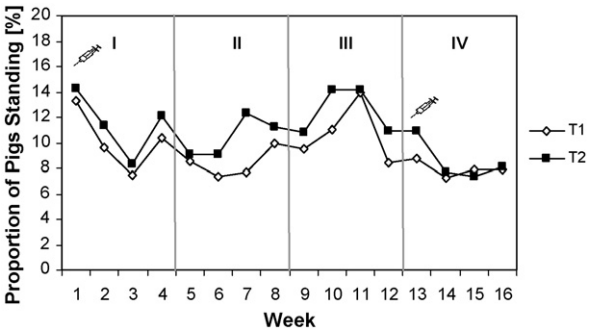

Fig. 1. Standing of surgically castrated (T1) and vaccinated (T2) male pigs in different weeks of the fattening period expressed as proportion of pigs standing. Least squares means calculated for a 24-h day. I–IV: fattening phase. ( ) 1st and 2nd vaccination of T2.

Table 2
Proportion of pigs in different postures calculated for the entire fattening period, for each fattening phase (I–IV) and for each week of fattening phase IV separately (weeks 13–16). Least squares means with standard errors (bracketed) and *P*-values of paired comparisons (*P*). T1 = group of surgically castrated male pigs and T2 = group of male pigs vaccinated with a GnRF vaccine.

	Standing			Sitting			Lying		
	T1	T2	*P*	T1	T2	*P*	T1	T2	*P*
Fattening period	9.31 (0.40)	10.74 (0.40)	0.023	2.57 (0.11)	2.58 (0.11)	NS	88.12 (0.41)	86.68 (0.41)	0.027
Fattening phase I	10.19^{b}	11.51^{bc}	0.046	2.59	2.56	NS	87.22^{a}	85.93^{ab}	NS
Fattening phase II	8.36^{a}	10.45^{c}	NS	2.36	2.47	NS	89.28^{b}	87.09^{bc}	NS
Fattening phase III	10.73^{b}	12.50^{b}	NS	2.67	2.47	NS	86.60^{a}	85.03^{a}	NS
Fattening phase IV	7.95^{a}	8.49^{a}	NS	2.67	2.83	NS	89.39^{b}	88.68^{c}	NS
Week 13	8.71	10.89^{a}	NS	2.26	1.94^{a}	NS	89.03	87.17^{a}	NS
Week 14	7.20	7.65^{b}	NS	2.49	2.57^{ac}	NS	90.33	89.78^{b}	NS
Week 15	7.94	7.36^{b}	NS	2.79	3.11^{bc}	NS	89.27	89.52^{b}	NS
Week 16	7.88	8.05^{b}	NS	3.13	3.70^{b}	NS	88.98	88.24^{ab}	NS

^{abc}Different letters within a column indicate significant differences between fattening phases or weeks within a treatment group. NS: not significant ($P > 0.05$).

Table 3
Frequencies of different aggressive behaviours per pig in 2 h calculated for the entire fattening period and for each fattening phase (I–IV) separately. Least squares means with standard errors (bracketed) and *P*-values of paired comparisons (*P*). T1 = group of surgically castrated male pigs. T2 = group of male pigs vaccinated with a GnRF vaccine.

	Agonistic interactions			Biting and fighting			Displacing and head knocking		
	T1	T2	*P*	T1	T2	*P*	T1	T2	*P*
Fattening period	2.09 (1.11)	2.70 (1.10)	NS	0.88 (1.15)	1.12 (1.12)	NS	1.14 (1.09)	1.51 (1.10)	0.028
Fattening phase I	2.77^{b}	3.87^{b}	NS	1.11	1.79^{b}	NS	1.57^{b}	2.04	NS
Fattening phase II	1.98^{ab}	2.32^{ac}	NS	0.78	0.93^{ab}	NS	1.08^{ab}	1.37	NS
Fattening phase III	1.37^{a}	2.88^{bc}	0.028	0.66	1.34^{b}	NS	0.70^{a}	1.47	0.040
Fattening phase IV	2.56^{ab}	2.05^{a}	NS	1.04	0.72^{a}	NS	1.42^{ab}	1.26	NS

^{abc}Different letters within a column indicate significant differences between fattening phases within a treatment group. NS: not significant ($P > 0.05$).

number of 'agonistic interactions' ($P = 0.064$). T1 and T2 did not differ in 'biting and fighting' ($P = 0.151$). A higher prevalence in 'displacing and head knocking' was found in T2 pigs ($P = 0.028$). The fattening phase (I–IV) and the observation block (A–D) affected agonistic interactions independently from treatment ($P < 0.001$). The observer effect ($P < 0.001$) on aggressive behaviour was corrected by the model.

A significant effect of the interaction between treatment and fattening phase on aggressive behaviour was found. Paired comparisons of treatment groups at different fattening phases revealed that T2 animals had a higher number in 'agonistic interactions' ($P = 0.028$) and 'displacing and head knocking' ($P = 0.040$) in phase III. In T2 the prevalence of 'agonistic interactions' and 'biting and fighting' decreased from fattening phase III (prior to the second vaccination) to phase IV (after second vaccination) ($P < 0.001$), which was not the case in T1 (Table 3).

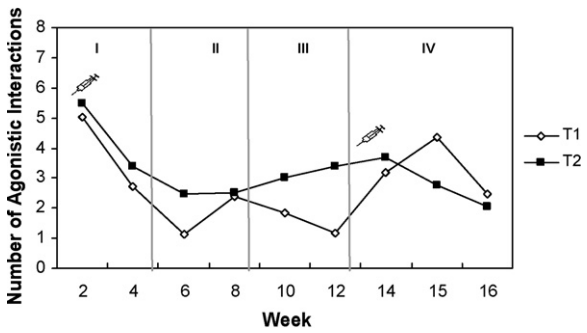

Fig. 2. Agonistic interactions of surgically castrated (T1) and vaccinated (T2) pigs in different weeks of the fattening period. Mean values of interactions per pig in 2 h. I–IV: fattening phase. (💉) 1st and 2nd vaccination of T2.

3.2.2. Non-aggressive behaviour

The treatment group had no effect on the prevalence of play behaviour or on the manipulating of pen mates. T2 animals showed a higher level of mounting behaviour compared to T1 animals ($P = 0.005$). The fattening phase and the observation block affected non-aggressive social behaviour independently from treatment ($P < 0.001$).

The paired analysis of the interaction between treatment group and fattening phase revealed that in T2 the frequency of play behaviour and mounting was significantly lower ($P \leq 0.01$) in fattening phase IV compared to the time before the second vaccination (Table 4).

4. Discussion

The present study, conducted under commercial conditions in a German fattening unit, demonstrates that male fattening pigs which had been surgically castrated in the first week of life were less active compared with males vaccinated with a GnRF vaccine (Improvac) at the beginning of the fattening period and 4 or 5 weeks prior to slaughter. This difference was consistent from the beginning of the fattening period to 2 weeks after the second vaccination of Improvac when vaccinates showed a significant decrease in activity.

Table 4
Frequencies of different non-aggressive social behaviours per pig in 2 h calculated for the entire fattening period and for each fattening phase (I–IV) separately. Least squares means with standard errors (bracketed) and *P*-values of paired comparisons (*P*). T1 = group of surgically castrated male pigs and T2 = group of male pigs vaccinated with a GnRF vaccine.

	Playing			Mounting			Manipulating of pen mate		
	T1	T2	*P*	T1	T2	*P*	T1	T2	*P*
Fattening period	0.09 (1.24)	0.12 (1.21)	NS	0.05 (1.48)	0.17 (1.24)	0.005	2.29 (1.07)	2.57 (1.08)	NS
Fattening phase I	0.19	0.42[b]	NS	0.27[b]	0.36[b]	NS	2.54	3.12	NS
Fattening phase II	0.07	0.31[b]	NS	0.06	0.27[b]	NS	1.73	1.94	NS
Fattening phase III	0.06	0.14[b]	NS	0.04	0.31[b]	NS	2.04	2.64	NS
Fattening phase IV	0.07	0.01[a]	NS	0.01[a]	0.03[a]	NS	3.08	2.74	NS

[ab]Different letters within a column indicate significant differences between fattening phases within a treatment group. NS: not significant ($P > 0.05$).

These results are in accordance with former findings by Cronin et al. (2003), who observed entire males, GnRF vaccinated and surgically castrated males pigs housed in groups of 15 animals and fed ad libitum from two single space feeders per pen. Velarde et al. (2008) also reported that before second vaccination, the activity was higher in vaccinated and entire males than in surgically castrated pigs. From 2 weeks after the second administration of Improvac, the incidence of activity was similar in immunocastrated and surgically castrated groups and significantly lower compared to entire males. Until the second vaccination the hypothalamic–pituitary–gonadal axis of vaccinates stays intact. An increased GnRF antibody titre and drop of luteinising hormone and steroids occur within 5 days (Claus et al., 2007). Compared with the studies of Velarde et al. (2008) and Cronin et al. (2003) the activity of the animals in our study was low in both treatment groups. A genetic background and factors such as barren environment, light intensity, stocking density, feeding regime and feed composition might explain the difference. Interestingly, the surgically castrated group was already less active at the beginning of the fattening period at 10 weeks of age. At this age the impact of hormones from the gonads on behaviour should be negligible. Plasma concentrations of androgens and estrogens in male domestic pigs show a peak at 2–4 weeks after birth, remain low from 2 to 5 months and rise markedly thereafter (Schwarzenberger et al., 1993).

Despite the difference in general activity, treatment effects on social behaviour parameters were less pronounced in our study. Both the total number of agonistic interactions and 'biting and fighting' did not differ between treatment groups. Our results indicate that conflicts in GnRF vaccinated animals were based on a low level of aggression. Velarde et al. (2008) did not find any treatment effects on aggression either. As in the study of Cronin et al. (2003) aggression decreased after the second dose of the GnRF vaccine which corroborates the effectiveness of the vaccination. Mounting behaviour in vaccinated males was more frequent than in surgically castrated pigs. However, mounting was observed infrequently in both treatment groups which is consistent with the low level of activity in our study. Cronin et al. (2003) reported a higher incidence of mounting prior to the second vaccination of Improvac compared to surgically castrates. The difference could be explained by the elimination of most of the sex play by neonatal castration (Berry and Signoret, 1984). After the second vaccination of the GnRF vaccine the number of mounts dropped down to the level of the castrates. In the study of Velarde et al. (2008) vaccinated males did not differ in mounting compared with surgically castrates at any time. Both in play behaviour, which is considered a positive welfare indicator (Newberry et al., 1988), and in manipulating of pen mates, which indicates a lack of materials for exploring and manipulating (Tuyttens, 2005) no treatment group effects were found.

5. Conclusion

Based on our results we conclude that housing of male fattening pigs to be managed with GnRF vaccination in single sex groups of 12 individuals does not increase behavioural problems in the fattening period compared to surgically castrated males. Further studies have to answer the question if aggressive and sexual behaviour increase disproportionately if groups of pigs are more active due to different genetic and environmental factors. Special attention should also be paid to the post-weaning period of entire male pigs. From an animal welfare point of view GnRF vaccination of male pigs is beneficial because it avoids surgical procedure, which is associated with pain and stress even when performed under local or general anaesthesia.

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