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Problems with aggressive and sexual behaviour when rearing entire male pigs

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Abstract

Our aim was to evaluate aggressive and sexual behaviour of entire males and their sisters. 408 pigs, raised in single-sex or mixed pens, were studied. Aggression level in the pen (ALP) during feeding and aggressive interactions (IA) between individuals competing for a small amount of feed were tested on 408 pigs at 130 and 155 days of age. Sexual behaviour (mounts) was recorded from 100 days of age. ALP was lowest in single-sex pens with females. ALP was higher at 130 days than at 155 days. A high ALP was related to higher average growth rate. IA increased after slaughter of the three most fast-growing pigs in each pen, although these were the ones that initiated a majority of IA earlier (at 130 days). There tend to be more sexual behaviour in single-sex pens with entire males than in mixed pens. Entire males perform much more sexual behaviour than females. More injuries were noted in single-sex pens with entire males than in single-sex pens with females. 15% of the entire males and 6% of the females had health problems related to lameness or injured legs or feet. Three entire males from single-sex and two entire males from mixed pens were euthanized due to lameness or leg fracture. Rearing of entire males may cause welfare problems, due to increased aggression levels and sexual behaviour.

Introduction

In welfare discussions about castration of pigs, generally only the pain during and shortly after the surgery, is considered. However, to stop castrating does not necessarily improve animal welfare. Entire male pigs are more likely to show aggressive and sexual behaviour and may therefore exhibit higher levels of injuries. The aim of this study was to evaluate aggressive and sexual behaviour of entire male pigs raised in mixed or single-sex pens.

Material and methods

408 crossbred (Swedish Landrace x Large White) entire male and female pigs from 40 litters were studied. They were raised either in mixed pens with 7 or 9 pigs in each, or in single-sex pens with 9 pigs in each. 3 separate stables were used: an entire male stable with 6 pens, a female stable with 6 pens and a mixed stable with 12 pens. The experiment started at an average weight of 24 kg. All pigs were fed the same diet restrictedly twice a day, according to a Swedish standard feeding regimen. In pens with 7 pigs, all pigs were slaughtered at an average weight of 115 kg. In pens with 9 pigs, the pigs were slaughtered at two occasions per pen. The three most fast-growing pigs (in mixed pens 2 entire males and 1 female) were slaughtered when they reached an average weight of approximately 90 kg, and the remaining 6 pigs were slaughtered at

an average weight of 115 kg. Thus, 4 treatments were studied: 1, mixed, 7 pigs; 2, mixed, 9-6 pigs, 3, entire males, 9-6 pigs; 4, females, 9-6 pigs. The pigs were raised in two batches, one in year 2002 and one in year 2003.

Tests of aggressive behaviour

Two types of tests were performed in this study: aggression level in the pen and aggressive interactions between individuals. Both tests were performed in replicate at two test occasions. First, all pigs were tested twice prior to the slaughter of the three most fast-growing pigs in the pen (mean age 132 days, SD 8 days). Secondly, all remaining pigs were tested twice a few weeks after the slaughter of the three most fast-growing pigs in the pen (mean age 155 days, SD 9 days). The two test occasions will be named as "at 90 kg" and "at 115 kg" throughout the article.

Aggression level in the pen (ALP). This test was performed during routine feeding. The feed was dispensed to the trough by an automatic feeder. The test was initiated when the first portion of feed reached the trough and lasted for 20 min. The following interactions between pigs were recorded: pushing another pig to reach the trough; mounting another pig to reach the trough; lifting another pig away; thrusting by head knocking or biting in the air; thrusting and chasing another pig away; biting; biting and chasing another pig away. Thrusting and biting (with or without chasing) were regarded as aggressive behaviours in this test. The identities of pigs involved in these interactions were not recorded, but the identities of the pigs not eating from the first portion of feed in the trough were identified in the first batch.

Aggressive behaviour of individuals (IA). This test was performed prior to routine feeding. Aggressive interactions (mount; lift; thrust; bite; chase) between individual pigs were provoked by introducing 1 kg of feed to the pen floor. The identities of pigs involved in these interactions were recorded for 5 min. The type of aggressive interaction was not recorded. From these records, the following individual parameters were determined: the number of initiated interactions (GIVE), the number of received interactions (GET), the difference between the numbers of initiated and received interactions (GIVE-GET), the number of interactions a pig was involved in (INTERACTIONS) and the ratio of number pen mates a pig interacted with to number of pigs in the pen (CONTACTS). If a pig interacts with 3 of 9 pen mates, CONTACTS is 0.33.

Sexual behaviour and injuries

Mounts. Sexual behaviour was studied in all pens with entire males (treatment 1-3) during the last month of the rearing period in the second year. The average number of days between first and last observation in the pen was 31.3 days (SD 11.9 days). The animals were observed for 20 minutes in each stable at 8.4 days (SD 2.6 days) and all matings were recorded. The identities of the mounting pig and the receiving pig were also recorded when possible. The identities are missing for 30% of the mounts.

Bites, scratches and lameness. In addition to the supervision included in the daily management, all pigs were inspected for health status from the age of approximately 100 days until slaughter. This inspection was done at 2-week intervals and in average, each pig was inspected 4.3 times (SD 1.3). Injuries were recorded as frequencies of deep and shallow scratches and bites at the head, front and back of the pig. In the analyses, sums of scratches and bites were used. Lameness and other problems related to legs and feet were also recorded.

Statistical analyses

Statistical analyses were performed with the procedures GLM and MIXED in SAS (SAS Institute Inc., Cary, N.C., USA, version 8.2). Results are presented as mean values of the

replicates at 90 kg and at 115 kg (except for results in table 1 and 3 where the replicates are included). χ^2-test was used to analyse differences in leg problems between treatments. Number of aggressive interactions in the pen during feeding (ALP), bites and scratches were transformed to $\log^{10}$ prior to the statistical analysis. Back transformations of values were performed when presenting mean values. The different models used are described in Results.

Results

Aggressive behaviour

At the first test occasion, the aggression level in the pen during feeding (ALP) was lowest in the single-sex pens of females, see table 1. No difference ALP variables was found between the other treatments. At the second test occasion, the differences between treatments in ALP variables were not significant.

Table 1. LS-means[1] of frequency of interactions between pigs, recorded in the feeding test (20 min.) at the first test occasion. N=47 pens. All frequencies correspond to nine pigs per pen

Behaviour	Treatment				p-value
	1, mixed 7 pigs	2, mixed 9-6 pigs	3, males 9-6 pigs	4, females 9-6 pigs	
Sum of social interactions	25^{ab}	34^{a}	24^{ab}	19^{b}	0.078
Sum of aggressive interactions	22^{a}	27^{a}	21^{ab}	14^{b}	0.036
Thrusting without or with chasing	14^{a}	16^{a}	14^{a}	8^{b}	0.056
Biting without or with chasing	6^{ab}	9^{a}	6^{ab}	4^{b}	0.151

[1] In the model: fixed effects of treatment, year and replicate and random effect of pen within treatment-year. Numbers with different superscripts differ ($p<0.05$).

When the pigs grew older they became less aggressive during feeding. The ALP variables were higher at 90 kg than at 115 kg, see table 2.

Table 2. LS-means[1] of frequency of interactions between pigs, recorded in the feeding test (20 min.) at first and second test occasion. N=48 pens. All frequencies correspond to nine pigs per pen

Behaviour	Test occasion		p-value
	at 90 kg	at 115 kg	
Sum of social interactions	27	19	0.012
Sum of aggressive interactions	22	16	0.022
Thrusting without or with chasing	14	12	0.328
Biting without or with chasing	7	2	0.001

[1] In the model: fixed effects of treatment, year and test occasion and random effect of pen within treatment-year.

ALP was higher in pens where the pigs had a high average growth rate from start of experiment to 90 kg. The partial correlation between the sum of social interactions and average growth rate in the pen at 90 kg was 0.37 (N=47 pens, p=0.016, fixed effect of treatment and year in the model). The corresponding correlation between thrusting and average growth rate was 0.38 (p=0.013).

The variables from the test of aggressive behaviour of individuals (IA) were repeated over time, as shown in table 3. To attack is a more repeatable behaviour than to receive attacks.

Table 3. Repeatability[1] (t) of variables recorded in the test of aggressive behaviour of individuals. N=83 pigs from treatment 1 (7 pigs, mixed), tested 4 times

	Variable	t
GIVE	no. of initiated interactions	0.60
GET	no. of received interactions	0.25
GIVE-GET	difference between no. of initiated and received interactions	0.59
INTERACTIONS	total no. of interactions the pig was involved in	0.41
CONTACTS	ratio of pen mates the pig interacted with	0.37

[1] In the model: fixed effects of year, test occasion and replicate and random effect of animal within year.

At the first IA test occasion, before any pigs were slaughtered, pigs in mixed pens with 7 animals (treatment 1) showed more aggressive behaviour than pigs from the other treatments with 9 pigs per pen, GIVE=2.75 versus GIVE=1.7-1.9 (N=404 pigs, $p<0.05$, fixed effects of treatment and year and random effect of pen within treatment-year in the model). There was no difference in IA variables between the other treatments.

Fast growing and heavy pigs attacked more than slow growing and light pigs (table 4). Number of received attacks was not related to growth rate or body weight. Pigs not eating from the first portion of feed in the trough were identified in the first batch. There was no difference in aggressive behaviour between pigs eating and pigs not eating at 90 kg. At 115 kg, pigs eating from the first portion were more aggressive in the IA test, GIVE=3.2 versus GIVE =1.0 for eating and non-eating pigs (N=150 pigs from all treatments in first batch, p=0.004, fixed effect of treatment in the model).

Table 4. Partial correlations[1] between variables recorded in the test of aggressive behaviour of individuals and growth rate and body weight. N=400 pigs, tested at 90 kg

Variable[2]	Correlation with growth rate from start to 90 kg	p-value	Correlation with weight deviation from pen average	p-value
GIVE	0.15	0.002	0.19	0.001
GET	0.00	1.000	-0.06	0.274
GIVE-GET	0.13	0.009	0.19	0.001
INTERACTIONS	0.14	0.006	0.14	0.004
CONTACTS	0.10	0.046	0.12	0.015

[1] In the model: fixed effects of treatment, year and sex within treatment.
[2] See table 3 for the acronyms.

In mixed pens (treatment 1 and 2), females were less aggressive than entire males, but there was no significant difference between females and entire males in number of received attacks (Table 5).

Table 5. LS-means[1] of variables recorded in the test of aggressive behaviour of individuals (5 min.). N=190 pigs from treatment 1 (7 pigs, mixed) and 2 (9-6 pigs, mixed)

Variable[2]	Entire males	Females	p-value
GIVE	3.0	1.9	0.012
GET	2.3	2.5	0.363
GIVE-GET	0.7	-0.7	0.015
CONTACTS	0.36	0.32	0.094

[1] In the model: fixed effects of treatment, year, test occasion and sex, deviation from average body weight in pen (regression) and random effect of animal within treatment-year-sex.
[2] See table 3 for the acronyms.

A comparison in aggressive behaviour was made between the 3 most fast-growing pigs in each pen and their 6 lighter pen mates. The differences in IA variables at 90 kg are shown in table 6. At this first test occasion, the most fast-growing pigs (to be slaughtered at 90 kg) initiated more aggressive interactions than the other pigs (to be slaughtered at 115 kg).

Table 6. LS-means[1] of variables recorded in the test of aggressive behaviour of individuals (5 min.) at 90 kg. Pigs to be slaughtered at 90 kg (the 3 most fast-growing pigs per pen) are compared with pigs to be slaughtered at 115 kg (the 6 remaining pigs per pen). N=321 pigs from treatment 2 (mixed, 9-6 pigs), 3 (males, 9-6 pigs) and 4 (females, 9-6 pigs)

Variable[2]	Type of pigs		p-value
	to be slaughtered at 90 kg N=108 pigs	to be slaughtered at 115 kg N=213 pigs	
GIVE	2.5	1.6	0.001
GET	1.9	1.9	0.954
GIVE-GET	0.6	-0.3	0.002
CONTACTS	0.30	0.25	0.007

[1] In the model: fixed effects of treatment, year and type and random effect of pen within treatment-year.
[2] See table 3 for the acronyms.

There were significant interactions between treatment and test occasion in the IA variables. These variables were therefore analysed for treatment 1 (mixed, 7 pigs) and treatments 2 (mixed, 9-6 pigs), 3 (males, 9-6 pigs) and 4 (females, 9-6 pigs) separately, to describe the effect of age on aggressive behaviour. Pigs in treatment 1 showed more aggressive interactions in the IA test at 90 kg than 3 weeks later at 115 kg. The opposite was found for pigs from treatment 2, 3 and 4 (table 7). In these pens, the number of aggressive interactions per pig increased when the three most fast-growing pigs were slaughtered. The average sum of attacks within pen remained unaffected (16.9 at 90 kg and 17.1 at 115 kg).

Table 7. LS-means[1] of variables recorded in the test of aggressive behaviour of individuals (5 min.), at 90 kg and 115 kg

Variable	Treatment 1, 7 pigs per pen			Treatments 2-4, 9-6 pigs per pen		
	at 90 kg N=83 pigs	at 115 kg N=76 pigs	p-value	at 90 kg N= 321 pigs	at 115 kg N=212 pigs	p-value
GIVE	2.8	2.1	0.026	1.9	2.9	0.001
CONTACTS	0.37	0.32	0.040	0.26	0.41	0.001

[1] In the model for treatment 1: fixed effects of year and test occasion and random effect of animal within year. In the model for treatments 2-4: fixed effects of year, test occasion and treatment and random effect of animal within year-treatment.

Leg problems and injuries

In total, 31 entire males and 12 females had problems with legs or feet. These problems seemed to be most common for entire males in single-sex pens (treatment 3), see table 8. Five pigs, which were entire males, had to be euthanized due to leg problems. Few deep bites and scratches were found at the inspections performed biweekly. Females in single-sex pens (treatment 4) tended to have fewer injuries than pigs in the other treatments (table 8).

Table 8. Leg problems and injuries observed at biweekly inspections

Health problem	Entire males, treatment 1-2 mixed N=96	Females, treatment 1-2 mixed N=95	Entire males, treatment 3 single-sex N=107	Females, treatment 4 single-sex N=107	p-value
Leg problems, % of pigs	12	4	18	7	0.010[1]
Euthanized, leg probl. % of pigs	2	0	3	0	0.070[1]
Bites, freq./pig[2]	1.7[a]	2.0[a]	2.3[a]	1.0[b]	0.001
Scratches, freq./pig[2]	2.7[a]	2.6[a]	4.7[b]	2.5[a]	0.001

[1] χ^2-test.
[2] Ls-means of frequencies. In the model: fixed effects of treatment, year and sex within treatment.

Sexual behaviour

Sexual behaviour was studied in the second batch, by direct observations during 20 minutes. More mounts per pen were observed in single-sex pens (2.1 mounts per pen in treatment 3) than in the mixed pens (1.0 and 0.6 mounts per pen in treatment 1 and 2), but the variation between pens was large and these differences were not significant (p=0.125, N=18 pens, fixed effect of treatment and random effect of pen within treatment in the model). Pigs that performed much mounting behaviour also received many mounts, the correlation between the frequency of mounts and the frequency of received mounts was 0.44 (p=0.001, N=150 pigs, fixed effect of treatment and sex in the model). As many, as 46% of the pigs were never observed mounting or receiving mounts.

The sex of both pigs could be identified at 69 mounts in mixed pens (treatment 1 and 2). In these pens, 91% of the mounting pigs and 43% of the receiving pigs were entire males. No correlation between leg problems and frequency of mounts or received mounts was found, but there was a relationship between sexual behaviour and bites and scratches (table 9).

Table 9. Partial correlations[1] between frequencies of injuries observed at biweekly inspections and sexual behaviour. N=150 pigs from the second batch, treatments 1-3

Type of injury	Correlations with			
	freq. of mounts	p-value	freq. of received mounts	p-value
Bites	0.11	0.173	0.16	0.052
Scratches	0.26	0.001	0.31	0.001

[1] In the model: fixed effects of treatment and sex within treatment.

Discussion

In mixed pens, entire male pigs were more aggressive than females, which is in accordance with Giersing (1998). The aggression level in the pen during feeding tended to be lower in single-sex pens with females than in single-sex pens with entire males and in mixed pens. Cronin et al. (2003) showed that entire males have more aggressive behaviour than castrates. When the pigs were provoked by a small amount of feed on the floor, pigs in small groups (7 pigs) showed more aggressive behaviour than pigs in larger groups (9 pigs). This may be an effect of the group size per se or of space allowance, since the size of the pen was the same for all treatments.

Aggressive behaviour of individuals was repeated over time in this study. Janczak et al. (2003) also found consistency, over time, in the aggressive behaviour of gilts. These results indicate a genetic variation in aggressiveness. Lövendahl et al. (2004) studied aggressive behaviour of sows when they were mixed in new groups. To show aggressive behaviour was found to be a heritable trait, whereas being a victim had heritability close to zero. This is in accordance with our study, where GIVE had a higher repeatability than GET.

Heavy pigs were more aggressive in this study. Kaminder (1991) also showed an effect of body weight on the frequency of aggressive behaviour. The relationship between growth rate and aggressiveness found in this study is probably more than an effect of body weight since the sum of aggressive interactions in the pen during feeding was correlated to the average growth rate in the pen. We found that aggressive pigs (high GIVE value) were more often among the ones eating of the first portion of feed in the trough than non-aggressive pigs (low GIVE value). This indicates a relationship between social rank and allowance to eat, which could influence growth rate. Social rank, recorded during feeding at a test station, had high heritability in entire males, and the genetic correlation between social rank and growth rate was positive (Jonsson and Jörgensen, 1989). Schinkel et al. (2003) propose genetic relationships between aggressiveness and lean growth.

To send the most fast growing and aggressive pigs from the pen to slaughter at a young age (19 weeks) does not decrease the amount of aggression in the pen. On the contrary, the aggressive interactions increase when some animals are removed. If there is no competition for resources, social groups live with little conflict, once the rank order is established (Fraser et al., 1995). When we removed some pigs, the remaining ones had to establish a new hierarchy. It is possible that the change in social environment still influenced the pigs at the second behavioural test, although it was performed 3-4 weeks after the slaughter of the first pen mates. If the group was kept intact, aggressive behaviour decreased with increasing age. Cronin et al. (2003) observed a lower activity level of entire males at 21 weeks than at 17 weeks, but no difference in frequency of aggressive behaviour.

Entire males perform much more sexual behaviour than females. Thus, there is more sexual behaviour in single-sex pens with entire males than in mixed pens. This is in contrast with Kaminder's (1991) observation of more sexual behaviour of entire males in mixed-sex folds than in single-sex folds outdoors. We saw more scratches and more leg problems in single-sex pens with entire males than in single-sex pens with females. The sexual behaviour probably disturbs all pigs in the pen, not only the one being mounted on. Entire males were more active than surgically castrated males in a study by Cronin et al. (2003). At 17 weeks, the entire males spent 22% of the time standing, as compared to 16% for castrates. Cronin et al. (2003) also found a higher growth rate in immuno-castrated males than in entire males, which they explain with a reduction in aggression and mounting events in immuno-castrated pigs.

A common definition of animal welfare (FAWC, 1992) states five freedoms; freedom from hunger and thirst, from thermal and physical discomfort, from pain, injuries and diseases and from fear and stress, and freedom to express normal behaviour. To stop castrating pigs may influence pig welfare with regard to most of these aspects. The mounting that entire male pigs perform probably decrease the welfare of male as well as female pigs.

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