Entire male pigs in farrow-to-finish pens—Effects on animal welfare

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Abstract

Aggressive and sexual behaviour can hamper animal welfare in entire male pig production. The aim of the present study was to investigate if rearing entire male pigs in sibling groups (in farrow-to-finish pens) could reduce aggressive and sexual behaviour and thereby improve animal welfare in entire male pig production. Frequencies of aggressive and sexual behaviour among finishing pigs were recorded in three different groups in one herd; FTF-group (entires + gilts, siblings), mix-group (entires + gilts, mixed) and castrate-group (castrates + gilts, siblings). Frequencies of skin wounds were recorded in this herd and in an additional herd (only FTF-group and mix-group) shortly before the animals were sent to slaughter. Higher skin lesion scores in the entire male pig groups were in accordance with the behaviour data. Rearing entire male pigs in sibling groups reduces aggressive behaviour, though the frequency of the aggressive behaviour bouts was still higher than it was in the castrate-group. The frequency of skin wounds in the FTF-group was reduced to similar levels as in the castrate-group. The findings suggest that rearing entire males in sibling groups may be an appropriate management strategy for improving animal welfare in entire male pig production.

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1. Introduction

Castration performed without anaesthesia in piglets is a painful operation and it represents a potential animal welfare issue (Prunier et al., 2006). In an attempt to improve animal welfare, the
Norwegian Parliament has passed a law banning the castration of piglets from 2009. Cessation of castration will relieve the animals from pain during and after surgery, but the rearing of entire males poses other welfare issues as entire male pigs are more aggressive and sexually active than castrates (Ellis et al., 1983; Giersing, 1998; Cronin et al., 2003). This could result in another animal welfare problem where high rank male pigs badger their pen mates of lower rank with biting, chasing and head knocks. Sexual behaviour (mounting of both gilts and boars) has also been reported as problematic, and can occasionally result in a high frequency of serious leg injuries to pen-mates (Rydhmer et al., 2004). It is important to recognise these problems and to find alternative rearing methods, which might ensure better animal welfare.

Mixing of unacquainted pigs is usually followed by fighting (especially during the initial hours) until a new rank order is established in the group (Petherick and Blackshaw, 1987; Moore et al., 1994). The fighting behaviour tends to be more prolonged and serious when the weight differences between pigs are small (Rushen, 1987; Moore et al., 1994; Andersen et al., 2000; Schmolke et al., 2003). Mixing pigs is a very common practice in Norwegian pig production (and in many other countries also) both after weaning and when transferred to the fattening unit. The intention of the mixing is to reduce and balance the weight differences between pigs within the pens and to make the most out of available space. According to previous reports (Fredriksen et al., 2004), this practice can exacerbate sexual maturation of entire male pigs compared to when rearing them in sibling groups, in farrow-to-finish pens. Moreover, aggressive and sexual behaviour increases during puberty while mixing and moving animals. Furthermore reestablishment of the hierarchy among the pigs in the pen provokes aggressive and sexual behaviour. The hypothesis for the present study was that by keeping littermates together in stable groups, this process might be avoided and the onset of puberty delayed, thus resulting in a lower frequency of unwanted behaviour, lower skin lesion scores and consequently improved animal welfare.

2. Material and methods

2.1. Herds and animals

The study was performed as a field study in two full-cycle herds. The herds and animals included in the study are described in detail elsewhere (Fredriksen et al., 2006) where herd A and B are referred to as herd 1 and 3, respectively. The production buildings had farrow-to-finish (FTF) pens that would keep the siblings together in the same pen from birth to slaughter. The pens were 8.8–9.2 m² and 26–28% of the floor area available was a slatted floor. The mean number of pigs per pen was 10.7 (S.D. = 0.8) and the minimum space allowance was 0.80 m² per pig. In herd A, a mixture of sawdust and cut straw was used as bedding, while only sawdust was used in herd B. The animals were of the type ‘Noroc’ (mother: Norwegian Landrace × Yorkshire, father: Norwegian Landrace × Duroc). Both herds practised wet feeding. In herd A, the feed was mixed at the farm and contained bread, soy, minerals and small amounts of concentrates mixed with water. The feed was automatically distributed four times per day. In herd B the feed consisted of concentrates and water, automatically distributed three times per day. In both herds the feeding regime was close to an ad libitum schedule. In herd A, 119 entire male pigs, distributed in 30 pens and 56 castrates distributed in 14 pens were included in the behaviour study, while 1354 animals (367 entires, 294 castrates and 693 gilts) were included in the study of skin lesion scores. In herd B, 484 animals (247 entires and 237 gilts) were included in the study of skin lesion scores. The pigs were slaughtered at an approximate carcass weight of 75 kg.

2.2. Study design—behaviour

The behaviour study included two rounds of slaughter in one herd (herd A). The sows were randomly distributed into one of three treatment groups prior to farrowing, the farrow-to-finish group (FTF-group), the
mix-group and the castrate-group. In the FTF-group (15 pens) and the castrate-group (14 pens), a standard FTF-system was used, keeping the litters together in the same pens from farrowing until transportation to slaughter. In the mix-group (15 pens), pigs from three different litters were mixed at about 25 kg live weight, and put into the pens in the new groups. Number of both males and females from each litter was balanced as good as possible in the new groups.

2.3. Study design—skin lesion scores

The study of skin lesion scores included two rounds of slaughter in two herds (herd A and B). In herd A, the same three groups as in the behaviour study were used, although a larger numbers of animals and pens were included (Table 3). In herd B, the sows were randomly distributed between two groups prior to farrowing. These two groups corresponded to the FTF-group and the mix-group in herd A.

2.4. Sampling and data recording

Recording of individual data in the herds and at slaughter was performed as previously described (Fredriksen et al., 2006).

2.5. Recording of behaviour

Behavioural observations within the herd were recorded 1–3 weeks before slaughter. Four randomly selected male pigs per pen were marked on their back with individually spray paint marks to facilitate observation. The observation period started five minutes before feeding and lasted for 55 min. The observation was repeated so that the four selected pigs in each pen were observed at two feedings on the same day, either at feeding 1 and 4, or feeding 2 and 3. All occurrences of bites, head knocks and mounting were recorded at an individual level. Head knock was defined as knocking the head into the head or body of another pig with the mouth closed. Biting was defined as ‘thrust with open mouth’. It was also noted whether the behaviour was directed against a gilt or another boar (or castrate in the castrate-group). The observer was sitting close to, and with a good overview of the pen, but out of reach of the pigs. The observations and recordings were performed by the same person.

2.6. Recording of skin lesion scores in the herds

Skin lesion scoring was performed at an individual level for all pigs. Scores from 0 to 3 were recorded for the forepart and for the hind part (score 0 meant no scratches, score 1 = 1–5 scratches, score 2 = 6–10 scratches and score 3 more than 10 scratches). The scores for the forepart and the hind part were summed so as to compute an individual skin lesion score. A pen index was also calculated as the sum of individual skin lesion scores divided by the number of pigs in the pen. Due to practical reasons the recordings were performed by three different persons, but treatment groups within a replicate were scored by the same person.

2.7. Recording of skin lesion scores at the slaughterhouse

All the entire males in the study were inspected for skin lesions after scalding and singeing. Scores from 0 to 3 were given for the carcass as a whole; where score 0 meant no scratches, score 1 = 1–5 scratches, score 2 = 6–10 scratches and score 3 more than 10 scratches. All the recordings were performed by one single person, who had not participated in the previous recordings in the herds.

2.8. Statistical analysis

The statistical analysis was performed in the SAS-PC System® Version 9.1 for Windows using both pig and pen as the statistical units. The procedures PROC UNIVARIATE, PROC MEANS and PROC FREQ
were used for the descriptive analysis. Non-parametrical methods were used for analyses of both behaviour data and skin lesion scores at individual level, and also for the behaviour data at pen level due to the non-normal distribution of the data. Wilcoxon scores (rank sums) were calculated, and a Kruskal–Wallis test was used to test for statistical differences between the three treatment groups. For multiple comparisons between treatments, a post hoc test described by Siegel and Castellan (1988) was used. In addition, differences between entire male pigs (FTF group + mix-group) and castrates (castrate-group) were analysed according to the behaviour data. A multiple regression model with skin lesion scores (pen level) as dependent variable was performed using PROC MIXED. Log-transformed values for skin lesion scores were used to achieve normal distribution of the dependent variable. To avoid invalid log values for the six pens with an index of 0, the index was set to 0.01. The fixed independent variables: herd, treatment group and skin lesion score records were all used as categorical variables in the model, while number of animals in the pen was used as a continuous variable. All the independent variables were included in the preliminary models using the type III F-test as the elimination criterion. The modelling was manually conducted by eliminating one single term at a time, using two-tailed tests and using a p-value of 0.05 as the level for exclusion from the model. The least square means were calculated for all levels of the significant independent variables in the final model. For the FTF-group and the mix-group the Spearman’s correlation coefficients were calculated between the behaviour parameters and skin lesion scores recorded in the herds, and between the skin lesion scores recorded in the herds and at the slaughterhouse, using the correlation procedure in SAS. For the correlation calculations, a behaviour index was created per animal as the sum of mean frequency of bites, mean frequency of head knocks and mean frequency of mounting. The calculations were computed both at individual and at pen level within treatment. At pen level the mean values per pen were used.

3. Results

3.1. Behaviour

The behaviour data is presented in Table 1, together with the significance levels for differences between the groups at individual level and pen level. The multiple comparisons between treatments are presented in Table 2. There were no differences in the distribution of the behaviour measures directed against males or females within the groups and therefore the data were merged. The frequency distributions for the behaviour recordings are given in Figs. 1–3.

3.2. Skin lesion scores in the herds

The number of animals included in the recording of skin lesion scores was 543 in the FTF group, 635 in the mix-group, and 660 in the castrate-group. The mean individual skin lesion scores

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Recordings (given by median (inter-quartile range)) of bites, head knocks and mounting per animal and observation period distributed by group treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>FTF-group</td>
</tr>
<tr>
<td>Number of animals</td>
<td>59</td>
</tr>
<tr>
<td>Number of pens</td>
<td>15</td>
</tr>
<tr>
<td>Bites</td>
<td>0.5 (1.5)</td>
</tr>
<tr>
<td>Head knocks</td>
<td>1.5 (2.0)</td>
</tr>
<tr>
<td>Mounting</td>
<td>0 (0)</td>
</tr>
</tbody>
</table>

Significance levels (p-values) for differences between the treatments.
scores per herd, replicate and treatment are given in Table 3. With regard to the individual skin lesion scores, significant differences were confirmed between all groups \((p < 0.0001)\). In the multiple regression model for skin lesion scores at pen level, the adjusted indexes were 0.36 for the FTF-group, 0.60 for the mix-group and 0.34 for the castrate-group \((p < 0.0001)\) when adjusted for the scorer. Neither herd nor total number of pigs in the pen was a significant factor in the model.

Table 2
Multiple comparisons between treatments (the FTF-group, the mix-group, the entire male group (FTF + mix-group) and the castrate-group) for the parameters bites, head knocks and mounting at individual level and at pen level

<table>
<thead>
<tr>
<th></th>
<th>Individual level</th>
<th>Pen level</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Bites</td>
<td>Head knocks</td>
</tr>
<tr>
<td>FTF-group–mix-group</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>FTF-group–castrate-group</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Mix-group–castrate-group</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Entire males (FTF + mix)–castrates</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Yes = significant at level 0.05.

Fig. 1. Frequency distribution of bites per treatment and observation period.

Fig. 2. Frequency distribution of head knocks per treatment and observation period.
3.3. Skin lesion scores at the slaughterhouse

The distribution of skin lesion scores recorded at the slaughterhouse is presented in Fig. 4. The mean scores were 0.60 in the FTF-group and 0.72 in the mix-group ($p = 0.05$, Kruskal–Wallis test).

3.4. Correlations

At an individual level there was a positive correlation between frequency of bites and frequency of head knocks both in the FTF-group ($r = 0.26$, $p = 0.04$) and in the mix-group ($r = 0.33$, $p = 0.01$). For the FTF-group there was also a positive correlation between the behaviour index and skin lesion scores recorded in the herd ($r = 0.35$, $p = 0.01$). The skin lesion score was more highly correlated to the frequency of head knocks ($r = 0.36$) than to the frequency of bites ($r = 0.27$). At pen level, none of the correlation coefficients were significant. There was no association between the skin lesion scores recorded in the herd and at the slaughterhouse.

4. Discussion

The results of the study confirm that entire male pigs are more aggressive and sexually active than castrates (Ellis et al., 1983; Giersing, 1998; Cronin et al., 2003). However, this
study demonstrates that entire male pigs reared in sibling groups are less aggressive and consequently have lower skin lesion scores than entire male pigs reared in mixed groups. The results are in accordance with the hypothesis that the FTF-system would reduce the frequencies of unwanted behaviour and skin lesions, and thus improve animal welfare in entire male pig production.

Ford (1990) indicated that aggressive and sexual behaviour is stimulated by testicular steroids (androgens and estrogens). Castration, which includes evisceration of the testes and consequently lapse of testicular steroids, will therefore result in a considerable decrease in the frequencies of such behaviour (Cronin et al., 2003). Aggressive behaviour is undesirable from an animal welfare point of view. Attempts at improving (pig) animal welfare may prove paradoxical, unless production solutions that minimize unwanted behaviour in pig systems can be proposed in terms of general husbandry, transport and lairage routines. The use of FTF-systems in entire male pig production has been successful in delaying puberty and in reducing the levels of androstenone in fat (Fredriksen et al., 2004, 2006). The current study also shows that the aggressive behaviour in pigs can be reduced in the FTF-system. Fighting and mating behaviour cause an increase in plasma testosterone, which also results in a concurrent increase in androstenone (Andresen, 1976; Claus et al., 1994). Furthermore, high rank is associated with high levels of testosterone and androstenone (Giersing et al., 2000). It seems reasonable to assume that there is a functional positive feedback system between high levels of androsterone/testosterone and aggressive and sexual behaviour.

Differences between the groups were demonstrated for frequencies of bites, head knocks and mounting. For mounting, there were only differences between the castrate-group and the combined test groups with entire males. However the frequencies of mounting must be considered as low in all groups, with a maximum mean of 0.23 incidents per observed male per period of 50 min (mix-group). Mounting could represent both dominant and sexual behaviour and in particularly, when pigs are feeding, it is probably a dominant behaviour used by high-ranking animals to attain access to the feed. Therefore the timing of the observation period was
probably not optimal for recording of sexual activity, but the recordings give indications of high-ranking males.

In our opinion the level of unwanted behaviour observed in this study toward con-specifics was moderate. Indeed it may be appropriate to question whether the level of undesirable behaviour observed in the mix-group was so high that it should be characterised as an animal welfare issue, but this is not easy to evaluate. Notwithstanding this issue however, even from a moderate starting point any reduction in unwanted or undesirable behaviour represents an improvement in welfare for the animals. The recording of behaviour was performed for only four randomly selected entire males per pen. Accordingly, the pen indexes do not give a complete picture of the situation in the pens. Preferentially all pigs should have been under surveillance and this could have been achieved by video surveillance, which unfortunately was not available during the study period.

Even though the number of animals and pens included in the behaviour study was limited (56–60 animals and 14–15 pens per treatment group), the observed differences in frequencies of bites and head knocks at individual level was significant at the 0.05 level between all groups. The observation of individual males was not independent, and preferably the analysis should have been performed at pen level. At pen level the differences were only significant between the mix-group and the castrate-group and between the combined entire male pig group and the castrate-group. This shows that the main difference in recorded behaviour was between entire males and castrates.

Analyses of skin lesion scores confirmed the results of the behaviour scores. The adjusted mean pre-slaughter skin lesion index in the FTF-group was almost halved compared to the Mix-group, and was almost identical to the index in the castrate-group. The association between the behaviour index and skin lesion scores at an individual level could only be proved for the FTF-group. The lack of association within the mix-group with both higher behaviour indexes and higher skin lesion indexes is not easy to explain. One possible explanation is that the aggressive pigs not necessarily get scratches themselves. Also in previous studies the association between aggressiveness and lesion score has been ambiguous. D’Eath (2002) showed that the presence of more aggressive pigs in a group, measured in a previous resident-intruder test, increased the total number of skin lesions, counted the day after mixing. In the same study, there was a tendency for less aggressive pigs within a group to have a greater number of lesions 4 days after mixing. Furthermore, Turner et al. (2006) showed that individual skin lesion score in 4-week-old pigs, measured 24 h after mixing, was associated with duration spent in reciprocal fighting and being bullied the last 24 h. In the present study, only the numbers of bites and head knocks were recorded. Another possible reason for the lack of association in the present study, is the low level of skin lesion scores recorded and the limited duration of behaviour recording. Another unexpected finding was that the frequency of head knocks was associated more strongly with the skin lesion scores than was the frequency of bites, however, this was also only significant for the FTF-group. Rydhmer et al. (2004) reported leg injuries caused by frequent mounting as a problem in entire male pig production. In the present study, no systematic recording of leg injuries was performed. However, leg injuries were not identified as a problem, and no animals were withdrawn from the study because of leg weakness.

The immediate effects of mixing unacquainted pigs, resulting in new rank establishing processes in the pen, are relatively well known (McGlone and Curtis, 1985; Rushen, 1987; Rundgren and Löfquist, 1989; Giersing and Andersson, 1998; Spoolder et al., 2000). The possible long term effect of mixing unaquainted pigs has received less attention. However, differences in the level of agonistic interactions between mixed groups and sibling groups of gilts
and castrates are present at least 5 weeks after mixing (Ekkel et al., 1997; Lund et al., 1998). In the present study, the mixing was done when the pigs were at approximately 25 kg live weight, while the observations of behaviour and skin lesions were performed just before slaughter. This shows that mixing at an early stage has consequences for the whole rearing period. A similar study (Ekkel et al., 1995) showed that production performance and both health and welfare were improved in a specific stress-free housing system, compared to pigs in a conventional system transported and mixed at 25 kg live weights. This is in accordance with a study by Rundgren and Löfqvist (1989) that showed that mixing of pigs at 23 kg live weight had a negative effect on daily weight gain and feed efficiency, in castrates but not in gilts. A study by Friend et al. (1983) could not demonstrate any effects on daily weight gain during 28 days after mixing. In the present study, the average weight gain was significantly higher in the FTF-group but only in herd B (Fredriksen et al., 2006).

While the effect of treatment on skin lesion index registered at the farm was highly significant, only a moderate effect of treatment was demonstrated for the score registered at the slaughterhouse, and no significant correlation coefficient could be demonstrated between the two parameters. These results appear to suggest that recording of skin lesion scores in pigs at slaughter may not be a suitable indicator of animal welfare in the herd. Karlsson and Lundstrom (1992) showed that animals (gilts and castrates) kept as a unit from start of the fattening period until slaughter, including at transport and lairage, had much fewer lacerations at slaughter than mixed pigs. Moss and Robb (1978), Moss (1978) and Bradshaw et al. (1996) also showed that mixing pigs at transport and/or lairage resulted in increased stress and increased frequency of aggressive behaviour. Additionally, mixing at transport and lairage can influence meat quality (Warriss and Brown, 1985; Faucitano, 2000). In the present study, both treatment groups were mixed at transport and lairage, and the scores given at the slaughterhouse, reflects probably to a large extent the fresh scratches obtained during transport and lairage. To make full use of the benefits of the FTF system, the groups should remain separate during both transport and lairage. Pigs from one pen are usually slaughtered over a period of several weeks because of the settling system used, the narrow weight range and so as to provide the optimal price to the farmer. This particular system makes it very hard to avoid the mixing of pigs during transport and lairage, and represents a welfare challenge for entire male pig production.

The FTF-system is not very widespread, and converting to FTF-system from conventional management most often requires a costly reconstruction of buildings. The direct influence of the presented findings on animal welfare is therefore limited. If, however, similar results can be obtained in conventional herds, by keeping the siblings together, and avoid mixing, the implications for animal welfare in entire male pig production can be considerable. This should be investigated further.

5. Conclusions

Increased fighting and sexual activity exposes animal welfare concerns in entire male pig production compared to production of castrates. The results of the current study indicate that rearing of entire male pigs with their littermates in farrow-to-finish pens represents an improvement in animal welfare, compared to rearing entire male pigs in a conventional system, which includes mixing of pigs from different litters. In traditional herds, pigs are moved and often mixed both at weaning and at the beginning of the finishing period. Further studies should be performed to investigate if the positive effect observed regarding androstenone, puberty attainment and animal welfare can be reproduced in conventional herds.
References


