Effects of former acquaintance on aggression, lesion and growth performance in weaned piglets after mixing

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ABSTRACT

Excessive aggression between weaned piglets after mixing is a welfare and production issue resulting in stress, injuries and economic losses. The aim of this study is to determine the effect of former acquaintance (FA) on aggression, lesion and growth performance in weaned, mixed piglets. The results showed that the FA group significantly reduced the number of fights, time spent fighting, number of bullying events, lesions, the average injury scores of the front site and middle site of weaned piglets after mixing. A significant interaction was found between the effects of sex and treatment on the number of fights won and bullying events, between the effects of days post-weaning and treatment on the lesion scores as well as between the effect of the lesion sites and treatments on the lesion score for all three days after mixing. The results suggested a potential welfare advantage to allow litters to have some acquaintance before weaning.

Key words: Aggression, Animal welfare, Former acquaintance, Mixing, Weaning.

INTRODUCTION

In the animal kingdom, mixing unfamiliar individuals throughout the same species will incur aggressive behaviors. Mixing unfamiliar piglets coming from different litters into groups after weaning is a common management practice in commercial production systems. Piglets will establish a hierarchy through fighting when unacquainted piglets are restructured together (Meese and Ewbank, 1973). However, fighting is thought to be an animal welfare issue that needs to be improved as it has seriously hindered the growth of animals (Pluske et al., 1997; Tan et al., 1990).

Currently, to lessen the aggression and harm resulting from fighting after mixing, much effort has been put into investigating the effect of environmental factors (the characteristics of the environment, pen size/shape, food competition) on aggressive behaviors in pigs (Arey and Franklin, 1995; Barnett et al., 1994; Melotti et al., 2011; Chaloupková et al., 2007). Empirical studies about the effects of social recognition on the aggression behaviors induced by mixing were also reported. Work by Petersen et al. (1989) has suggested that the formation of social bonds in pigs may be facilitated during a critical period when piglets could be mixed with low levels of fighting. Actually, a previous study hinted that mixing different litters of piglets with access to a full-time open creep area before weaning resulted in a higher feed intake and weight gain after the weaning of piglets compared to piglets without mixing (Weary et al., 2002). However, it is still not clear whether limited communication between different litters before weaning helps to reduce the aggression induced by mixing after weaning of piglets.

Thus, in the present study, we attempted to investigate the effects of former acquaintance before weaning on the aggression, lesion and growth performance of mixed piglets after weaning to provide information about reducing the aggression induced by mixing piglets after weaning. In practical production, piglets are often regrouped at diverse proportions after weaning, which will result in different levels of aggression between piglets (Mei et al., 2016). Therefore, this study took the reported mixing level (with a 3:3 ratio of mixing at the age of weaning) as the most aggressive mode as previous research has shown that this mixing level is associated with higher fighting activity and more skin lesions than did other mixing levels after regrouping the unfamiliar animals at weaning (Mei et al., 2016). All these results contribute to providing insights into understanding the important role of social recognition in relieving the stress incurred by aggressive behaviors after mixing unacquainted piglets at weaning.

MATERIALS AND METHODS

Experimental animals and housing: The 12 litters of crossbred piglets ((Landrace x Yorkshire) x Duroc) used in the study were born of 12 multiparous sows at Ju Wang of Chongqing, China, a standard commercial farm. The housing and management of sows and piglets were the same to previous reports (Mei et al., 2016). Six piglets (3 males, 3 females) out of each litter were randomly chosen through excluding underweight (less than 2 kg), overweight (more than 5 kg) and unhealthy piglets on the 21st day and were randomly allotted to either the FA (former acquaintance) treatment group or the control group. Both of the treatment groups

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consisted of 6 replicates with 6 piglets in each. The piglets in every two litters of the FA group had conterminal pens and contacted each other regularly and quantitatively (10 minutes per time, five times per day, at 8:00 h, 10:00 h, 12:00 h, 14:00 h and 16:00 h). The piglets in the control group were kept in the original litter (there is no contact with the other litters). The 72 piglets were weaned and regrouped into 12 new pens comprising 3 males and 3 females from 2 different litters with balanced genders and weaning weights at 28 days old. During the mixture process, 3 male piglets from one litter were mixed with 3 females from the other litter to avoid sex differences. Each replicate consisted of 6 piglets (3 males, 3 females) from two different litters. The 6 litters from the FA were mixed, and the 6 litters of the control group were mixed separately. Every two FA groups were assigned in the conterminal pens on the 21st day and were regrouped on the 28th day. Each of the piglets was numbered from 1 to 6 on their left and right abdomen with a non-toxic black marker. Weaning was carried out between 10:00 and 14:00 o’clock. Each piglet could only be used in one experiment. The experimental procedures followed the actual law of animal protection that was approved by the Animal Care Advisory Committee of Southwest University, China.

**Experimental instruments:** The video recordings were produced by using a monitor that was installed over each pen in a diagonal position at a height of 2.3 m, permitting a bird’s eye view of the whole pen. A total of 11 h of video recordings were registered in this way during the first 2 days after weaning and mixing (day 1: 5 h, day 2: 6 h). All the videos were stored in a computer for subsequent analysis.

**Data collection**

**Aggressive behaviors at weaning and on the second day after weaning:** To collect information on each individual, the aggressive behaviors were continuously observed for 5 h (day 1) after the last piglet entered the pen. These behaviors included fighting, bullying, biting, head-knocking and chasing. The definition of the observed behaviors and the distinction between the given and received behaviors are shown in Table 1. In the study, the monitor system of Melotti et al. (2011) was employed. A one-hour scan sampling (starting at 8:00 h, 10:00 h, 12:00 h, 14:00 h, 16:00 h and 18:00 h) was conducted on the second day.

**Lesion score:** The total number of lesions was assessed on the front (including head, neck, front legs and shoulders), middle (including the body after the shoulders up to the frontal tip of the hind legs) and rear parts (including the hind legs until the tail) of the piglets at 5 h (day 1), on the second day (day 2) and on the third day (day 3) after mixing. The score and severity of skin injuries were measured using the modified system of Melotti et al. (2011) (a classification ranging from 0 to 4 as the severity increased). For each area of the body, skin lesions were ranked from 0 to 10 according to severity: A ranking of 0 indicates no lesions, a ranking of 1 indicates ≤5 superficial lesions (scratches), 2 represents 6–10 superficial lesions or ≤5 deep lesions (evidence of hemorrhage), and so on, while 10 represents ≥45 superficial lesions or ≥41 deep lesions.

**Growth:** The body weight was measured at weaning and on day 3 (19:00) post-weaning to estimate the growth caused by weaning and mixing in piglets.

**Statistical analysis:** The data were analyzed using SPSS 20.0 (IBM; New York City, NY, USA). ANOVA was used to examine the effects of different categorical independent variables on the dependent variable, with variance between groups assessed by Levene’s test for the quality of variances, and post hoc Tukey’s HSD test was performed for multiple comparison. To analyze the differences in the behaviors between the FA group and the control group, an independent sample t-test was conducted. One-way ANOVA was used to test the effects of lesions at different sites and lesions on the day post-weaning. Two-way ANOVA was used to test the effects of the post-weaning day, treatment, sex, weight and their interactions. All data are presented as the means ± standard error.

**RESULTS AND DISCUSSION**

**Aggression and Lesion score:** During the observation of the first 5 h (Table 2), the results showed that weaned piglets

<table>
<thead>
<tr>
<th>Behavior</th>
<th>Definition</th>
</tr>
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<tbody>
<tr>
<td>Fight*</td>
<td>Bouts of vigorous biting and head-knocking occur. Both pigs engage with the other, each apparently trying to injure the other. Winners were identified when the other pig turned away and then moved away, avoiding the winner (D’Eath, 2002).</td>
</tr>
<tr>
<td>Bully*</td>
<td>The actor engages in close social contact with the recipient, including bouts of biting and head-knocking. The recipient moves away without retaliation (Similar to fighting, but there is no attempt to fight back by the recipient) (D’Eath, 2002).</td>
</tr>
<tr>
<td>Bite</td>
<td>This was recorded when one pig delivered a knock with the head against the head, neck or body of the other pig with the mouth open (Jensen and Yngvesson, 1998).</td>
</tr>
<tr>
<td>Head-knock</td>
<td>Including head to head knocking and head to body knocking. The actor makes a rapid sideways or upwards movement of its head delivering a blow to the recipient pig (D’Eath, 2002).</td>
</tr>
<tr>
<td>Chase</td>
<td>Following another pig in quick pursuit, usually biting or trying to bite (Erhard et al., 1997)</td>
</tr>
</tbody>
</table>

Recorded behaviors were marked with an asterisk (*)
Table 2: Effect of FA on aggressive behaviors in piglets 5 h after mixing

<table>
<thead>
<tr>
<th>Aggression variable</th>
<th>Control</th>
<th>FA</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Latency to first fight</td>
<td>604.33±106.92</td>
<td>1189.50±166.71</td>
<td>0.018</td>
</tr>
<tr>
<td>No. of fights</td>
<td>29.5±5.27</td>
<td>4.33±1.41</td>
<td>0.004</td>
</tr>
<tr>
<td>Time spent fighting</td>
<td>1832.5±578.84</td>
<td>116±49.61</td>
<td>0.031</td>
</tr>
<tr>
<td>Mean duration</td>
<td>116±49.61</td>
<td>23.68±3.36</td>
<td>0.077</td>
</tr>
<tr>
<td>Proportion of fighting time (%)</td>
<td>10.18±3.22</td>
<td>0.65±0.28</td>
<td>0.031</td>
</tr>
<tr>
<td>Time spent bullying</td>
<td>196.67±37.08</td>
<td>70.33±21.03</td>
<td>0.014</td>
</tr>
<tr>
<td>No. of bullying</td>
<td>18±2.46</td>
<td>10.67±2.09</td>
<td>0.047</td>
</tr>
</tbody>
</table>

Time is recorded in seconds. Data is recorded in per group. The same as following tables and figures.

in the FA group had lower numbers of fights (P<0.01) and bullying events (P<0.05), spent less time fighting (P<0.05) and bullying (P<0.05) and increased the latency to first fight (P<0.05) compared with the control group. The differences were also found on the second day (day 2) with respect to the number of fights (P<0.05), time spent fighting (P<0.01) and number of bullying events (P<0.01) (Table 3). FA also incurred fewer skin lesions during the period of the first 5 h, day 2, day 3 and the whole three days after mixing (5 h: P<0.01; day 2: tendency: P=0.06; day 3: tendency: P=0.095; whole three days: P=0.001. Fig. 1; 2) compared with piglets in the control group. A significant interaction was found between the effects of the post-weaning day and the treatment on lesion score (P<0.01). Weaned piglets in the FA group thereby showed an overall lower aggression after being mixed. FA contributed to relieving aggression and associated skin lesions. These results were supported by a previous study that indicated piglets with access to other litters fought less than did those in the control group when mixed at weaning.

![Figure 1](image1.png)

Figure 1: Lesion score was assessed at 5 h, day 2 and day 3 after weaning. Con=control group; FA=FA group.

![Figure 2](image2.png)

Figure 2: Total lesion score for three days. M=male piglets; F=Female piglets. Total = male piglets and female piglets. Con=control group; FA=FA group.

![Figure 3](image3.png)

Figure 3: Total lesion score for the front, middle and rear part for three days after weaning. Con=control group; FA=FA group.

Table 3: Effect of FA on aggressive behaviors in piglets on the second day after mixing

<table>
<thead>
<tr>
<th>Aggression variable</th>
<th>Control</th>
<th>FA</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of fights</td>
<td>5.00±0.89</td>
<td>2.67±0.49</td>
<td>0.046</td>
</tr>
<tr>
<td>Time spent fighting</td>
<td>85.67±14.75</td>
<td>29.40±5.53</td>
<td>0.004</td>
</tr>
<tr>
<td>Mean duration</td>
<td>30.83±10.86</td>
<td>16.77±3.71</td>
<td>0.265</td>
</tr>
<tr>
<td>Proportion of fighting time (%)</td>
<td>0.98±0.43</td>
<td>0.33±0.14</td>
<td>0.181</td>
</tr>
<tr>
<td>Time spent bullying</td>
<td>83.80±16.82</td>
<td>49.33±13.29</td>
<td>0.137</td>
</tr>
<tr>
<td>No. of bullying</td>
<td>12.40±1.12</td>
<td>6.67±1.31</td>
<td>0.010</td>
</tr>
</tbody>
</table>
The lack of recognition between newly mixed unfamiliar piglets appears to act as a triggering mechanism that initiates an intense aggressive response (Fraser, 1974). It is thus not difficult to understand that mixing before weaning can relieve the aggressive behaviors that are induced by the mixing of weaned piglets.

The study by Horrell and Hodgson (1992) indicated that sows and piglets can recognize each other through smell and the surrounding environment from the first day of birth. In contrast, pre-weaning mixing can gradually reduce their smell differences and increase the sense of intimacy between animals (Petersen et al., 1989). In our study, to remove the disturbance of sows during the process of pre-weaning recognition, sows were confined to the original pen with their own litter. Litters had regular and quantitative contact with another litter during the fourth week at lactation. Based on the reported latency to the first fight in a study by Mei et al.

![Figure 4: Latency to first fight (a), Number of fights (b), Time spent fighting (c), No. of fight won (d), No. of initiating a fight (e) and No. of bullying (f) at 5h after weaning. M=male piglets; F=Female piglets; H=heavy piglets; L=Light piglets. Con=control group; FA=FA group.]

![Figure 5: Weight loss in the 3 days following weaning and mixing. M=male piglets; F=Female piglets. Total=male piglets and female piglets. Con=control group; FA=FA group.]

with piglets from other litters (Weary et al., 2002). The lack of recognition between newly mixed unfamiliar piglets appears to act as a triggering mechanism that initiates an intense aggressive response (Fraser, 1974). It is thus not difficult to understand that mixing before weaning can relieve the aggressive behaviors that are induced by the mixing of weaned piglets.
The bases of sow-piglet identification. 1. The identification by sows of their own piglets and the presence of intruders. *Appl Anim Behav Sci.* **33**: 319-327.

**Weaning weight and growth:** In the present study, there was not a significant difference in the weight at weaning between the control and FA group or between female and male piglets (control: 6.20±0.18 kg, FA: 6.03±0.16 kg, P>0.05; males: 6.10±0.18 kg, females: 6.13±0.17 kg, P>0.05). Additionally, there was not a significantly different weight loss in the three days following mixing (Fig. 5) between the control and FA groups. Growth was unaffected by a 2-way interaction between sex and treatment (P>0.05). The result showed that there was not significantly different weaning weights or weight loss between the FA group and the control group. So we speculated that even though the piglets with lower aggression after being mixed in the FA group consumed less energy to fight for social status, the difference is not enough to remove stunted growth, even though the study by Weary *et al.* (2002) indicated that mixing different litters of piglets before weaning will contribute to improve their development (Weary *et al.*, 2002).

In conclusion, pre-weaning regular and quantitative acquaintance significantly relieved aggressive behaviors and skin lesions after the mixing of weaned piglets. Former acquaintance thereby improved the production efficiency and alleviated the weaning and mixing stress. All of these results will be helpful for the management, production and animal welfare of weaning piglets.

**ACKNOWLEDGEMENTS**

This study was supported by the Science and Technology Innovation Foundation of Social Livelihood of the People of Chongqing (Grant No.csct2016shmszx80063). We gratefully acknowledge Tao Mei who kindly provided the animals and the farm staff for their assistance during this study.

**COMPETING INTERESTS**

The authors declare that they have no conflict of interest.

**REFERENCES**


