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 of induced by mixing after weaning of piglets.

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 managment 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...
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-knock 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>23.6±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.

![Fig 1](image1.png)  
**Fig 1:** Lesion score was assessed at 5 h, day 2 and day 3 after weaning. Con=control group; FA=FA group.

![Fig 2](image2.png)  
**Fig 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.

![Fig 3](image3.png)  
**Fig 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±4.53</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.
(2016) and some other studies (Weary et al., 2002; Melotti et al., 2011), the contact time in our study was set up for 10 minutes per time, 5 times per day to relieve the aggressive behavior caused by long-term mixing. Furthermore, fights on day 2 after mixing resulted in lower levels of aggression and skin damage compared with those on the first day of mixing, suggesting that the social hierarchy had been established gradually. Additionally, with respect to the lesion score, there was a significant interaction between the effect of lesion sites and treatments on the lesion score for the whole three days after mixing (P<0.001). Lesions of the front part of the weaning piglets were more serious than were those of the middle and the rear in the control group (front: P<0.001; middle: P<0.001, Fig. 3), which further supported previous studies (Rundgren and Löfquist, 1989; Colson et al., 2006; Melotti et al., 2011; Mei et al., 2016). This result also indicated that the attacks received on the rear parts were reduced as the lesion of the rear parts generally included the hind legs until the tail (Rundgren and Löfquist, 1989; Melotti et al., 2011), and all piglets were processed following standard commercial practices of tail docking. Additionally, the work by Melotti et al. (2011) indicated that the scores for these parts were positively correlated with the number of attacks received. And FA can reduced the attacks, which provided proof in the observed significantly reduced lesion scores of front and middle sites between the control group and FA group.

**Effects of sex:** The results showed that males won more fights (P=0.019) and bullied more frequently (P=0.022) than did females in the control group (Fig. 4 a-f). A significant interaction was found between the effects of sex and treatment on the number of fights won (P<0.05) and on bullying (P<0.05). Additionally, females in the FA group had more skin lesions for the whole 3 days than did males (P=0.001, Fig. 2). These finding echoed the report of Val-

**REFERENCES**


**ACKNOWLEDGEMENT**

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**CONFLICT OF INTEREST**

The authors declare that they have no conflict of interest.


