



The effect of mixing levels on aggression at weaning in piglets



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ABSTRACT

This study was undertaken to investigate the effects of mixing levels on aggressive behaviors at weaning in piglets. In this study, 144 28-day-old piglets, which were from 24 litters, were weaned and relocated to four experimental tests with different mixing proportion (A: 6:0; B: 5:1; C: 4:2; D: 3:3), and mixed into 24 pens comprising three males and three females from two different litters with the balance of sex and weaning weight. Latency involving in the first fight, number, duration and initiator of fights, fight outcomes and bullying events were scored for 5 h and 1 day after mixing and skin lesions were counted at 5 h, day 1 and day 2 after mixing. Data were analyzed using a general linear model (GLM-ANOVA) to test the effects of post-weaning day, mixing level, sex, weight and their interactions. Overall, with the increase of mixing level, the number of fights ($P < 0.001$), time spent fighting ($P < 0.001$), mean duration of a fight ($P = 0.019$), time spent bullying ($P = 0.009$) and lesion ($P < 0.001$) on the day of mixing increased. Males won more fights ($P < 0.001$), initiated more fights ($P < 0.001$), bullied more frequently ($P < 0.001$) and have been inflicted more skin lesions (not significant). Meanwhile, heavier pigs won more fights ($P = 0.03$), initiated more fights ($P = 0.02$) and bullied more frequently ($P < 0.001$). In conclusion, growing mixing level increased aggression, lesion and weight loss after mixing. Sex and weight were related to some aspects of fighting behaviors.

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1. Introduction

The welfare and production issue of farm animals has been of increasing public attention in recent years. In modern intensive pig husbandry, piglets are exposed to various stressors in their lives. Piglets are confronted with abrupt separation from the sow, movement to a strange environment, dietary changes and digestive system disorders at weaning, which strongly affect their growth, health and welfare (Pluske et al., 1997; Tan and Shackleton, 1990; Akkermans et al., 2004). Of these, the mixing of unfamiliar conspecifics is one powerful stressor for piglets (Groot et al., 2001). The introduction of animals into pens appears to disrupt the normal process of hierarchy formation, with dominant animals directing most of their aggression to the rank immediately below, until the dominance relationships are settled (Meese and Ewbank, 1973). There are indications that post-weaning mixing of unfamiliar pigs leads to vigorous aggression behaviors (Erhard et al., 1997; Giersing and Andersson, 1998; Algers et al., 1990; D'Eath, 2002), immediately following mixing and up to 3 weeks afterwards (Meese

and Ewbank, 1973). Post-weaning mixing not only has increased aggression in later life, but also badly affected productivity of piglets (Milligan et al., 2001; Gonyou et al., 1988; Stookey and Gonyou, 1994).

To lessen the harm resulting from aggression, numerous authors have devoted themselves to identifying the causal factors (the characteristics of environment, pen size/shape, weaning age, food competition) that explain aggressive behaviors in pigs (Arey and Franklin, 1995; Barnett et al., 1993, 1994; Melotti et al., 2011; Chaloupková et al., 2007). In the meantime, many authors also have focused on the functional aspects (sex, weight and personality type) of aggression (Erhard and Mendl, 1997; Jensen and Yngvesson, 1998; D'Eath, 2002; Fels et al., 2014). Yet, few authors have studied the effect of both causal factors and functional aspects on aggression (Melotti et al., 2011).

In addition, much effort has been put into investigating the effects of mixing unfamiliar pigs in groups after weaning on aggression in commercial pig production (Arey and Franklin, 1995; Spooler et al., 2000; Colson et al., 2006; Melotti et al., 2011). The relationship between weight asymmetry and aggression has been described. The heavier pigs deliver significantly more bites, body lesions and fighting duration than the lighter ones, with heavier pigs fighting longer and winning more fights (Erhard et al., 1997; Melotti et al., 2011). Males tend to have a shorter latency to be

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involved in the first fight, have a shorter latency to win the first fight, and tend to not only initiate more aggression than females (Colson et al., 2006), but also win more fights than females in farm animals (Melotti et al., 2011). In the study, sex and body weight will be considered as the independent variables to investigate the effect of interaction on aggressive behaviors.

Some studies have showed that the increasing group size increased the risk of aggression (Turner et al., 2001; Andersen et al., 2004). Actually, mixing unfamiliar piglets coming from different litters in groups after weaning is a common practice in intensive production systems, and the proportion of mixing is often varied, even though the group size is constant. Additionally, in actual production, in order to reduce the stress of weaning mixed group, mixing two litters of different piglets is the usual practice. To the best of our knowledge, the effect of different mixing level with the mixing method between every two litters of piglets on aggression has yet not been investigated.

In the study, we investigated the effects of mixing levels on aggressive behaviors after weaning. Moreover, skin lesions, weight gain of pen mates were also assessed and the interactions among the effects of sex, weaning weight and mixing level on aggression were analyzed. We assumed that the higher the mixing levels are, the more serious the aggression and body lesions will be. All these results contribute to finding the optimal mixing degree, which will give insights into minimizing stress incurred by aggressive behaviors after mixing unacquainted pigs.

2. Materials and methods

A total of 144 piglets ((Landrace X Yorkshire) X Duroc) from 24 litters were divided into four experimental groups (Group A, B, C, D) with different mixing proportion, Group A with no mixing (control), Group B with 5:1 ratio mixing, Group C with 4:2 ratio mixing, Group D with 3:3 ratio mixing at the age of weaning.

2.1. Animals and housing

144 piglets were born from multiparous sows at a standard commercial farm “Ju Wang” of Chongqing, China. 24 sows were respectively assigned to an identical farrowing pen 5 days prior to farrowing. Farrowing pens measured 2.1 × 2.0 m, had slatted floor, and provided wooden kennels (1.0 × 0.6m, 0.6 m high) in one corner of the pen with a heat-lamp (22 °C), straw (1 kg per pen) and a piglet feeder. All sows were confined in a farrowing crate throughout lactation. The litter size was kept at 8–10, with a 50–50% sex ratio through excluding underweight (less than 3 kg), overweight (more than 9 kg) and unhealthy piglets on the 21st day. The piglets were kept with their mothers in farrowing pens for the whole lactation. Sows and piglets were respectively fed the same standard feed during the first 3 weeks of lactation. The feed was gradually switched to a weaner diet for piglets during the fourth week.

144 piglets were then weaned in the maternity room on the day 28.56 ± 0.14 (mean ± S.E.M.). Before being moved to the post-weaning pens, piglets were weighed (body weight was ranked within litter) and sexed just after weaning and 6 (3 males, 3 females) out of the 8–10 piglets of each litter were randomly chosen and kept in the study. The average body weight was measured at weaning (mean ± S.E.M.: 6.30 ± 0.10 kg; from 3.08 to 8.90 kg) and on day 3 (19:00) post-weaning.

Each of the four treatment groups consisted of six replicates. All the treatment groups were designed at different mixing ratio as above. During the mixing process, always the male piglets from one litter were transferred to the other litter to conform to the 50/50 sex ratio. Each replication contained 6 piglets (3 males, 3 females) from two different litters. Each replication of 6 piglets was placed in the

Table 1
Definition of observed behaviors.

Behavior	Definition
Fight*	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).
Bully*	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).
Bite	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).
Head-knock	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).
Chase	Following another pig in quick pursuit, usually biting or trying to bite (Erhard et al., 1997)

Recorded behaviors were marked with an asterisk (*).

same post-weaning pens, with the same environment condition. All piglets were identified by numbering (from 1 to 6) on their left and right abdomen with a non-toxic black marker. All piglets were processed following standard commercial practices (teeth clipping, tail docking, ear notching and males were castrated on the day 15 after birth). All these interventions were performed by the same animal caretaker.

All the tests were conducted in the same room, with indoor temperature (16–26 °C) and natural light and dark cycle during the tests. The photoperiod was 12 h light/12 h darkness (from 19:00 h to the next day 07:00 h). During the whole experimental process, food, drinking water and enough feeding space (0.70 m² per piglet) were provided.

2.2. Experimental installations

The video recordings were registered using a monitor, installed over each pen in diagonal position at a height of 2.3 m, permitting a bird's eye view of the whole pen. And the videos were stored in a computer for later analysis. 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). Weaning was carried out between 10:00 and 14:00 o'clock.

2.3. Data collection

2.3.1. Aggression at weaning

The study began with continuous observations on all piglets lasting 5 h (day 1) as the last piglet entered the pen. The definition of observed behaviors and the distinction between given and received behaviors are shown in Table 1. Every aggressive encounter that lasted at least 10 s and included at least five head-knocks or/and bites was recorded as a fight. Two consecutive fights from the same couple of pigs had to be at least 30 s apart from each other, or else, it would not be considered as two separate fights. If the interval was shorter than 30 s, the two encounters were considered as one (Melotti et al., 2011). The total number of fights, the duration of each fight (in seconds), the latency (from start of mixing to first fight won and to first fight lost), the initiators, the winners and the losers (the winner was defined as the pig that delivered the last bite in a fight and forced the other pig to withdraw) were recorded. Fighting triads were considered too rare to be included in the data analysis (The fighting triads that are consistent with the evaluation criteria of the latency to start the first fight will be recorded). A

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