

Short-term behavioural effects of weaning age in outdoor-reared piglets

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Age at weaning affects the behaviour of piglets weaned in conventional confined environments. The adaptation of piglets to this event, which exposes piglets to important stressors, has not been examined in detail in outdoor systems. The aim of this study was to compare the behaviour of piglets weaned at 3 or 4 weeks of age in an outdoor production system. Six replicates of four piglets born and raised outdoors, originated from different litters but previously acquainted, were weaned at the age of approximately 20 (D20) or 30 (D30) days in 36 m² outdoor pens and offered high-quality diets. Their behaviour was recorded by direct visual observation during four consecutive days after weaning (days 1 to 4). Data were analysed by repeated measures ANOVA. An effect of weaning age was observed on feeding and rooting ($P < 0.01$), and a day-by-weaning age interaction for escape attempts, vocalizing, walking and fighting ($P < 0.01$), and playing ($P < 0.03$). Compared to D30 piglets, D20 piglets showed a higher frequency of escape attempts on day 1, vocalized more during days 1 and 2, and walked more during days 1 to 3 ($P < 0.05$). Feeding behaviour, on the other hand, was higher in D30 piglets on days 1 to 3 ($P < 0.05$). On days 3 and 4, D30 piglets spent more time interacting with peers (playing and fighting; $P < 0.05$) and on day 4 were more active than D20 piglets ($P < 0.05$). As previously reported in confined environments, age at weaning affected the behaviour of piglets raised on the outdoors system. Weaning appeared to be more stressful for the piglets at 3 than at 4 weeks of age. The impact of weaning age on welfare cannot be ignored, especially when outdoor breeding of pigs is proposed to address welfare concerns of the public.

Keywords: pig, housing, social, ingestive, welfare

Implications

Increasing the age at weaning from 3 to 4 weeks improves the welfare of piglets reared outdoors by reducing distress behaviours and improving feeding behaviour. This is relevant considering that a key reason for rearing pigs in outdoor environments is to address ethical concerns of consumers regarding the wellbeing of the animals.

Introduction

Conventional weaning in the pig industry involves exposing young piglets to several concomitant stressors: transfer to a novel environment; separation from the sow and littermates, often mixing with unknown peers; and the loss of the main source of nutrition, i.e. milk. Because this is done

without a period of transition necessary to make the solid feed attractive to the piglets, weaning generally is followed by a period of low feed intake (Weary *et al.*, 2008). Additionally, at this age the digestive system of the piglets is not adapted to digest solid feed, which predisposes the young animals to diarrhoea and secondary infections (Dong and Pluske, 2007). In order to overcome this problem, diets especially designed for the digestive system of very young piglets have been formulated (Dritz *et al.*, 1996). However, because the behaviour of piglets weaned at very young ages indicates distress and suffering (Weary *et al.*, 2008), the age for weaning should not be defined solely based on the performance of the animals.

When lactation takes place in enriched, as opposed to conventional housing environments, the piglets' responses to weaning generally involve lower frequencies of aggression and abnormal behaviours, and higher frequencies of playing, feeding and resting behaviours (Webster and

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Dawkins, 2000; Cox and Cooper, 2001; Hötzel *et al.*, 2004), as well as higher growth rates in the post-weaning period (O'Connell *et al.*, 2005). Some factors that may underlie the different behavioural responses to weaning in piglets reared in conventional or outdoor systems are the opportunity to contact piglets of other litters during lactation, which decreases fighting after weaning (Pitts *et al.*, 2000; Weary *et al.*, 2002), and the reduction in suckling frequency, which seems to encourage the piglets to explore solid food and spend time away from the sow (Hötzel *et al.*, 2004). Also, access to a richer physical environment containing pasture, soil or other materials that allow piglets in outdoor environments to express exploratory and ingestive behaviours during lactation (Hötzel *et al.*, 2004; Leite *et al.*, 2008) may increase feeding behaviour in the immediate post-weaning period, thereby reducing the period of starvation that usually accompanies weaning (Bruininx *et al.*, 2002; Weary *et al.*, 2002).

Although the effects of weaning age on the behaviour (Bøe, 1993; Weary *et al.*, 1999a; Worobec *et al.*, 1999) and physiology (Colson *et al.*, 2006; Poletto *et al.*, 2006; Jarvis *et al.*, 2008; Sumner *et al.*, 2008) of piglets are well documented, no studies on age comparison have been carried out with piglets housed in outdoor systems. Even considering that the stress response to weaning may be reduced by a richer lactation environment, age at weaning may influence the piglets' behaviour. The aim of this study was to compare the behavioural response of piglets reared and weaned in outdoor housing, weaned at 20 or 30 days of age.

Material and methods

Animals

This study was carried out in the outdoor pig-breeding facilities of the Federal University of Santa Catarina, in Florianópolis, Brazil (27°S), from December to April (summer and early autumn). The piglets used in the present study were born and raised throughout the lactation period in the same outdoor unit. Before weaning, the piglets were reared in extensive outdoor collective maternity, where they had contact with several sows and their litters since birth.

From a group of 33 litters of Large White × Landrace × Duroc sows and three Pietran × Large White sires, 12 groups of four piglets, balanced for live weight, gender and litter of origin, were formed. Each group had piglets from four different litters; two castrate males and two females, two lighter and two heavier than the average weight of the group. Piglets were weaned at an average age of 20 (ranging 19 to 21 days, 6.7 ± 0.1 kg, D20) or 30 days (ranging 28 to 34 days, 7.5 ± 0.1 kg, D30).

After weaning, six groups of four piglets from both D20 and D30 treatments were installed in 36 m² enclosures with a 1 m² open shelter. In these enclosures, the piglets had access to earth, and pasture that could be used for foraging activities, but had low nutritive value. Fresh water was freely available in a bowl drinker. A 1 m-wide feed trough located under the shelter was used to provide *ad libitum*

Table 1 List of behaviours observed and respective description

Behaviour	Definition
Lying	Weight of body is not supported by legs
Sitting	Posterior of the body trunk in contact with the ground and supports most of the body weight
Standing	Piglet stands on four limbs
Walking	Piglet moving between points in space, either walking or running
Escape attempts	Piglet trying to escape the enclosure, lifting the fore limbs on fence or jumping
Vocalizing	Piglet emitting vocal sound
Rooting	Piglet making nasal contact with parts or objects of the pen or paddock while engaged in active exploration, stirring the ground with the snout
Feeding	Head of piglet over or within feeder, or piglet chewing with food in mouth
Grazing	Piglet making nasal contact with pasture or chewing it, or mouth moves in contact with pasture
Drinking	Mouth in contact with drinker
Oral–nasal interactions directed toward other piglets	Repeated oral–nasal contact, like biting, sucking or nosing body parts of other piglet, which avoids the interaction; belly nosing: rhythmic movement of snout against belly or other body part of other piglet
Fighting	Any behaviour indicative of social conflict such as threat, attack and fight – instigator; or escape, avoidance and subordination – victim
Playing	Two piglets engage in physical interaction in which one or both pushes, forces its head against the other or bites the other piglet; does not involve winner and loser
Inactive	Animal is not performing any activity

access to a commercial ration appropriate to the age, containing 21.1% crude protein, 3.77% fat, 3.0% crude fibre and 3218 kcal of metabolizable energy/kg (Poli-nutri Alimentos Ltda., Maringá, Paraná, Brazil).

Weaning was carried out between 0800 h to 1200 h of day 1. Behaviour was recorded by direct visual observation (Altmann, 1974), during four consecutive days, from 1400 h to 1800 h, starting on day 1. The position of each piglet and its behaviour (Table 1) was registered by instantaneous sampling carried out every 1.5 min – with a 1 min gap every 10 min – totalling 576 observations/pen per day.

The effect of age at weaning on the performance of the piglets, which has been presented and discussed elsewhere (Alexandre Filho, 2002), is not included in this article.

Effects of weaning age ($n = 6$ groups/treatment) and post-weaning day on frequency of every behaviour, and interactions between both, were analysed by repeated measures analysis of variance, after verification of homogeneity of the variance. Fisher's protected LSD was used *post hoc* to test for differences between weaning ages within days. Data are presented as mean \pm s.e.

Results

Piglets' positions are shown in Figure 1. There was no main effect of weaning age on lying or standing position, although there was an interaction between weaning age and day ($P < 0.01$) on lying and standing ($P < 0.01$) behaviours, which showed opposite trends. Lying increased, whereas standing decreased, from the first to the last day of observation. Piglets in the D20 treatment spent more time sitting than D30 piglets ($P < 0.05$), but there were no significant day effect or day-by-weaning age interactions.

Behaviours are shown in Figure 2. There was an interaction between weaning age and observation day ($P < 0.01$), and a main effect of weaning age ($P < 0.01$) for vocalizing, escape attempts and walking. Vocalizations occurred on days 1 and 2 and were higher ($P < 0.05$) in D20 than D30 piglets. Escape attempts were observed only in D20 piglets, and mainly on day 1. Walking was higher in D30 than D20 piglets on days 1 and 3 ($P < 0.01$) and decreased with time in both groups.

There was a main effect of weaning age on rooting and feeding ($P < 0.01$), and of days after weaning on grazing ($P < 0.001$). Feeding was higher in D30 than D20 piglets on days 1 to 3, whereas rooting was higher in D30 than D20 piglets on days 1, 3 and 4.

There was an interaction between weaning age and observation day ($P < 0.01$), and a main effect of weaning age on fighting ($P < 0.01$), as well as playing ($P < 0.03$, for both weaning age and interaction). Fighting was higher ($P < 0.05$) in D30 than D20 piglets in all days except on day 2. Playing was low during days 1 and 2 in both groups, and

increased in D30 but not in D20 piglets ($P < 0.05$) during the following 2 days.

There was a main effect of weaning age on drinking, which was higher on D30 than on D20 piglets (0.52 ± 0.1 and 0.35 ± 0.1 , respectively; $P < 0.02$). There was also a weaning age-by-day interaction and an effect of day on the occurrence of inactive piglets ($P < 0.001$). The number of observations increased from days 1 to 4 in both groups, and on day 4 differed between D20 and D30 piglets (439.0 ± 11.7 and 317.8 ± 35.2 , respectively; $P < 0.05$). Oral-nasal interactions directed toward other piglets and drinking were very low in both groups (less than two and six observations/day, for each group on average).

Discussion

Higher frequencies of vocalizations, walking and attempts to escape the enclosure, and lower frequencies of feeding and social interactions observed in D20 piglets, compared to D30 piglets, indicate that piglets reared outdoors have more difficulty adapting to weaning at 20 than at 30 days. In general, the age difference in the behavioural response of piglets reared in outdoor enclosures at weaning was similar to that reported for conventionally housed pigs (Weary and Fraser, 1997; Worobec *et al.*, 1999; Colson *et al.*, 2006). It must be pointed out that differences in the piglets' stage of development, which, in the present study, cannot be differentiated from responses to weaning, may explain some differences observed between the treatments.

The present results support other studies that have shown that increasing weaning age can help improve piglets'

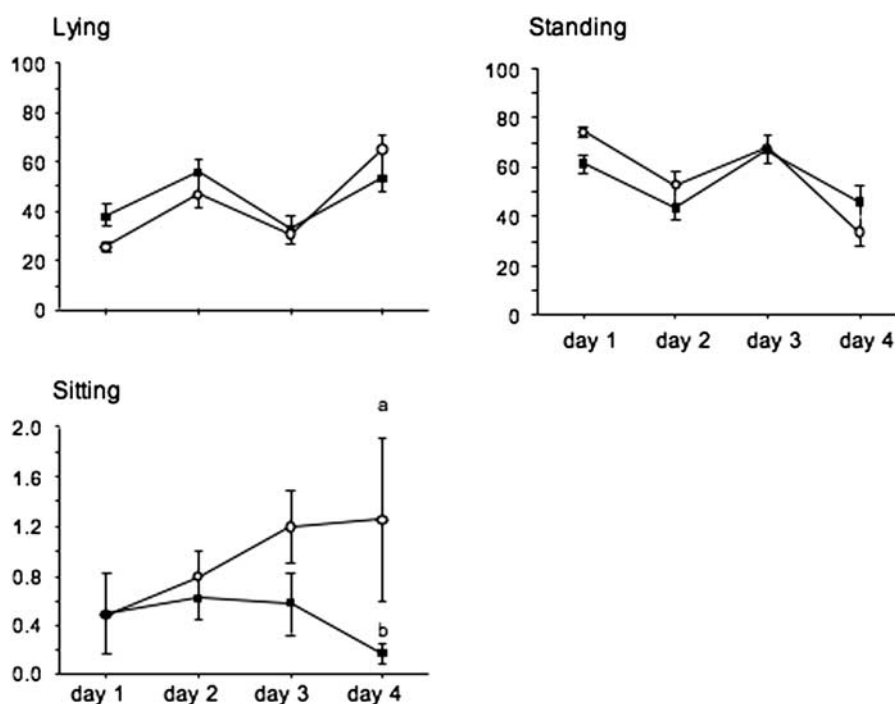


Figure 1 Frequency of positions of outdoor reared piglets (mean \pm s.e.) weaned at 20 (\circ) or 30 (\blacksquare) days of age, during the first 4 days after weaning (total observations = 575). Day 1 = day of weaning. Differences (LSMeans) between treatments for each day are shown: ab ($P < 0.05$).

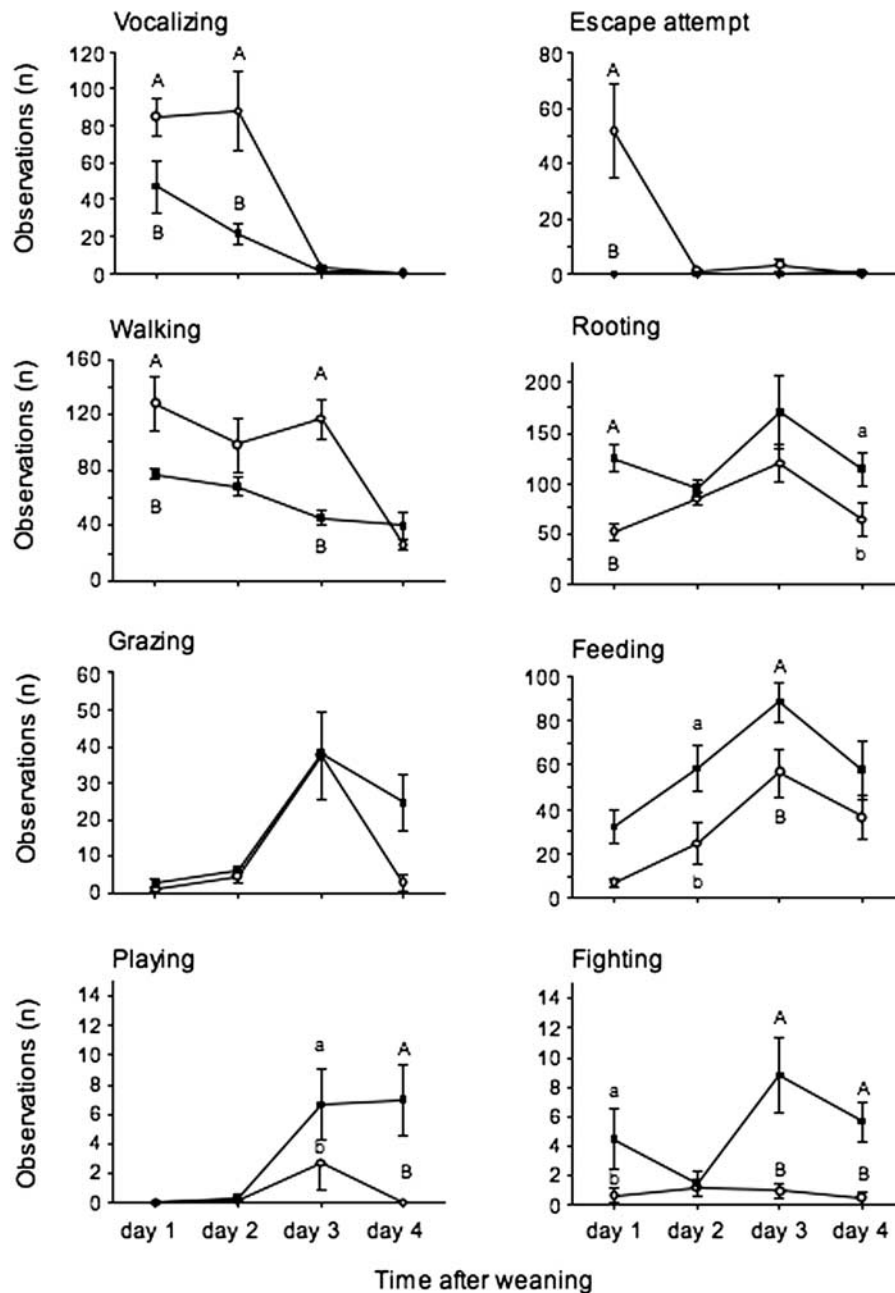


Figure 2 Frequency of behaviours of outdoor reared piglets (mean \pm s.e.) weaned at 20 (○) or 30 (■) days of age, during the first 4 days after weaning (total observations = 575). Day 1 = day of weaning. Differences (LSMeans) between treatments for each day are shown: ab ($P < 0.05$) or AB ($P < 0.01$).

feeding behaviour or intake after weaning (Gonyou *et al.*, 1998; Worobec *et al.*, 1999; Main *et al.*, 2004). Low energy intake at weaning is the most important factor affecting small intestine villous height of piglets after weaning (Marion *et al.*, 2002), and has known negative effects on the piglets' metabolism, growth and health (Le Dividich and Sève, 2000; Dong and Pluske, 2007), thus being a major welfare issue. The distress associated with the separation from the sow and the inexperience with ingestion of solid feed at this age possibly underlie the low feeding behaviour during the first days after weaning, with a stronger effect on the youngest group. Intakes of solid feed and feeding

frequency tend to be low during the first weeks after birth if piglets are with the sow (Weary *et al.*, 2002; Colson *et al.*, 2006). Additionally, intakes are highly variable among litters and within littermates (Pajor *et al.*, 1991), and not all piglets consume solid feed when it is offered during lactation (Bruininx *et al.*, 2002). As higher intakes before weaning improve intake after weaning (e.g. Bruininx *et al.*, 2002), it has been proposed that one key goal for improving the welfare of piglets at weaning is to achieve high intakes of solid feed before weaning (Weary *et al.*, 2008). The outdoor system presents some conditions that may help increase feed intake in the immediate post-weaning period. For example,

piglets are exposed to a large group of non-littermates and sows, which could increase their learning of solid-feeding by social facilitation (Morgan *et al.*, 2001). Furthermore, piglets have the opportunity of experiencing foraging behaviours during lactation through rooting and grazing (Hötzel *et al.*, 2004; Leite *et al.*, 2008) and of spending time away from the dam (Leite *et al.*, 2008), which has been shown to increase solid-feed consumption after weaning (Weary *et al.*, 1999b; Weary *et al.*, 2002). Indeed, weanling piglets from outdoor systems have higher feeding frequencies compared to indoor-housed piglets (Cox and Cooper, 2001; Hötzel *et al.*, 2004). Despite all these advantages, in the current study, feeding behaviour was low during the first days after weaning and was lower during the first 3 days in the earlier- than in the later-weaned groups. This suggests that, to be effective, any management aiming at increasing piglets' feed intake in the post-weaning period needs to be associated with an increase in weaning age.

Vocalizations are thought to convey information about the emotional state of young animals prematurely separated from the mother (Newberry and Swanson, 2008). Frequencies of vocalizations after separation from the sow are higher in piglets weaned at earlier than later ages (Weary and Fraser, 1997; Weary *et al.*, 1999a; Colson *et al.*, 2006), in smaller, lighter piglets (Weary and Fraser, 1995; Weary *et al.*, 1996), in piglets kept in colder environments (Weary *et al.*, 1997) and in piglets treated aversively during lactation (Hötzel *et al.*, 2007). Though the high frequency of calls observed during the first 2 days after weaning in both treatments – varying from 3.5%–13.0% of the total observations – suggests that weaning was stressful for piglets of both ages, the lower call frequency in D30 than in D20 piglets indicates a better transition to weaning in the older piglets.

Lower frequencies of social interactions, both aggressive and playful, were observed in younger-weaned piglets, suggesting a state of emotional apathy in the younger animals. Usually, high levels of harmful aggression follow weaning when litters are mixed in conventional rearing systems (e.g. Weary *et al.*, 1999b). Low frequencies of fighting following weaning in this study may have a number of reasons. First, the piglets that formed the new groups were acquainted during lactation, which is known to reduce fighting after mixing (Pitts *et al.*, 2000; Weary *et al.*, 2002; D'Eath, 2005); second, at weaning, these piglets were housed in a large enclosure with relatively low density, where they had the opportunity to root, which is known to reduce peer-directed behaviours (Van de Weerd *et al.*, 2005). Additionally, because of the higher environmental stimulus, outdoor piglets play more during the lactation period (Johnson *et al.*, 2001; Hötzel *et al.*, 2004), which is also thought to reduce fighting after weaning (O'Connell and Beattie, 1999).

The low frequencies of play behaviour in the first days in both groups indicate a distress response to weaning, while the rise in playing behaviour of D30 piglets on days 3 and 4 after weaning suggests an earlier adaptation to weaning than in D20 piglets. As suggested by Donaldson *et al.*

(2002), the negative emotions associated with the separation from the dam may suppress playing behaviour in young piglets by interfering with the 'having fun' component of playing, proposed by Špinka *et al.* (2001). Alternatively, since the ontogeny of social play peaks after 4 weeks of age in piglets (Newberry *et al.*, 1988), the lower frequency of engaging in playful social interactions observed in younger-weaned piglets may also be attributed to differences in the piglets' development.

In conclusion, the acute behavioural response to weaning observed in piglets reared in an intensive outdoor system is, in general, similar to that described in several studies carried out in conventional confined systems (Bøe, 1993; Gonyou *et al.*, 1998; Weary *et al.*, 1999a; Worobec *et al.*, 1999; Colson *et al.*, 2006). Although weaning appears to be less stressful for piglets in outdoor than in confined systems (Cox and Cooper, 2001; Johnson *et al.*, 2001; Hötzel *et al.*, 2004), this study shows that age at weaning influences the adaptation of outdoor-reared piglets to weaning, and that a considerable improvement can be achieved from the 3rd to the 4th week after birth.

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