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A synthetic olfactory agonist reduces aggression when sows are mixed into small groups

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ABSTRACT

Synthetic olfactory agonists mimic odours secreted by mammary glands in several mammal species and their application can reduce anxiety levels in both juvenile and adult animals. This investigation determined the effect of a commercially available synthetic olfactory agonist administration on behaviour, salivary cortisol secretion and level of injury after sows were mixed into groups. Within five days of mating sows were divided between two treatments according to parity: 24 control sows (CON), and 24 that received the synthetic olfactory agonist (SOA) by being housed with diffusing blocks. Sows were mixed in groups of six, with two replicate pens contained within each of the two rooms, allocated a space allowance of 2.4 m^2 and offered 2.7 kg/day of a dry sow diet. Sow behaviour, injury counts and saliva samples were collected on days 0, 1, 3 and 7 following the mixing event. In the afternoon of day 7, the SOA diffusing blocks were removed and measurements were collected again on days 8 and 14. On day 0, the mean ± SEM $\log_{10}$ average number of aggressive events recorded per sow was reduced in the SOA (1.0 ± 0.08; back-transformed mean 10.6 events) when compared with CON treatment (0.8 ± 0.08; 5.9 events; $P < 0.05$). These results were mirrored on almost all other measurement days ($P < 0.05$), with the exception of day 14, when the incidence of aggression did not differ between treatments ($P > 0.05$). Sows were also observed to rest for a $\log_{10}$ longer duration in the SOA treatment than in CON (4.14 ± 0.02; 230.1 min versus 4.10 ± 0.02; 209.8 min respectively; $P < 0.001$) on the day of mixing. When averaged across the experimental period, sows from the SOA treatment ate for longer (3.62 ± 0.03; 69.6 min) and more often (1.12 ± 0.04; 13.2 events) when compared with CON sows (3.52 ± 0.03; 54.7 min and 1.02 ± 0.04; 10.4 times respectively; $P < 0.05$), but there was no impact on weight gain ($P > 0.05$). After the diffusing blocks were removed from the SOA treatment, a rise in aggression was detected in SOA (2.2 ± 1.1 events per sow) but not CON sows (0.38 ± 1.0 events per sow; $P < 0.05$). No treatment effects were observed on injury counts, salivary cortisol concentrations, or conception rate ($P > 0.05$). These findings support the hypothesis that the provision of a synthetic olfactory agonist can reduce aggression in adult sows at mixing, providing a novel strategy to improve the welfare of group housed sows.

1. Introduction

Pork industries are shifting from the continual, individual housing of sows in stalls to the use of group housing options. The group housing of sows allows for a greater freedom of movement as well as an increased ability for socialisation, and it is argued that this results in significant welfare improvements. The point at which grouping occurs and the length of time sows will spend in group housing during gestation will differ between farms, and also between countries due to variation in legislation. Regardless, all sows moved into groups will have to be introduced to unfamiliar animals at least once.

When sows are first introduced to one another, a new social hierarchy must be established. Whilst initially appearing chaotic, the formation of dominance-submission relationships reduce aggressive interactions in the longer term (Jensen, 1982). The hierarchy results from acts of aggression, with more aggressive individuals achieving dominance over less, and gaining places higher in the social order. The aggression that is observed during hierarchical formation is often said to be the cause of periods of acute stress in sows (Arey, 1999; Barnett et al., 2001). The heightened aggression and stress represents not only a welfare concern, but may also negatively impact upon important production measures

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such as reproductive output (Kongsted, 2004) and incidence of lameness (Chapinal et al., 2010).

There has been considerable research aimed at reducing the level of aggression that is observed when sows are mixed into groups. Whilst it would appear that some factors, such as large space allowances, are effective in reducing the number of fights that occur (Weng et al., 1998), rigorous recommendations on the requirements that meets both the behavioural needs of the sow as well as the financial requirements of the producer are lacking (Greenwood et al., 2014). This suggests that in addition to further exploration into known factors, novel strategies to reduce sow aggression should be investigated.

Pigs have a highly developed olfactory system (McGlone and Anderson, 2002) and the importance of pheromones for puberty attainment (Kirkwood et al., 1981), and mating receptivity (Pearce and Hughes, 1987) are well understood. Maternal secretions from nipples and milk have been shown to meet all the criteria for definition as a pheromone (Schaal et al., 2003), acting to attract and calm the offspring, as well as elicit teat seeking behaviour (Schaal, 2010). Synthetic olfactory agonists commercially known as 'appeasing pheromones' mimic these maternally derived fatty acid secretions and have been shown to bind to both the nasal and vomero-nasal mucosae (Guiraudie et al., 2003). Synthetic 'appeasing pheromones' have been used successfully in other domesticated species, with the most common application being in dogs. 'Dog appeasing pheromone' is utilised where high anxiety levels are typically witnessed such as in veterinary clinics, shelters or during storm or firework events (Frank et al., 2010). Less is known about their effectiveness in livestock species. Experimentally, newly mixed, weaner piglets have been shown to engage in less aggression, visit the feeder more often, and consequently display a higher average daily weight gain when a 'synthetic pheromone' was applied to either the feeder or nose of the pig (McGlone and Anderson, 2002). These findings have been supported on a larger scale, with reduced aggression and injuries in weaner piglets reported when housed in contact with the 'synthetic pheromone' under more commercial conditions (Guy et al., 2009). The effects of 'appeasing pheromones' are not limited to juveniles, with a reduction in cortisol synthesis reported in adult, miniature sows when mixed into pairs (Yonezawa et al., 2009). To date, there have been no reports on the effects of synthetic maternal olfactory agonists on the behaviour and stress of commercial, group housed sows.

The aim of this investigation was to examine the effects of a synthetic olfactory agonist on the levels of aggression and stress when sows were first introduced to one another under group housing conditions. We hypothesised that the presence of the synthetic olfactory agonist diffusers would reduce aggression at mixing, improving the welfare of sows during this stressful procedure.

2. Materials and methods

2.1. Animals

This investigation was carried out with approval from the University of Adelaide Animal Ethics Committee. Forty-eight Large White cross Landrace sows were weaned from their litters and housed in individual sow stalls. All sows were multiparous, with an average parity of 3.5 ± 0.3 (range 2–8). Sows were allocated to treatment in order to ensure an even parity distribution, mated when a standing reflex was observed during the back pressure test in the presence of a mature boar, and subsequently received three inseminations 24 h apart. Four to five days after the first mating, sows were removed from stall housing and placed in group pens which marked the beginning of the experimental period. Sows were floor fed once daily 2.7 kg of a standard dry sow diet (13.0 MJ DE/kg) and had ad libitum access to water via three nipple drinkers.

2.2. Animal housing and treatment

This experiment was completed in two replicates, with four group pens investigated within each of the two replicates. The pens were partially slatted, with over half of the floor consisting of solid concrete, and were rectangular in shape (Fig. 1). Each pen contained six sows, giving a space allowance of 2.4 m^2 per sow. Group pens were enclosed in two rooms that shared no ventilation, but were identical in design. Two control pens (CON) were located in the first room and no synthetic olfactory agonist was present in this room. The second room also housed two pens, and in this room, four diffuser blocks containing the synthetic olfactory agonist (Securepig® IRSEA, Quartier Salignan France) were installed to create the treated group (SOA). The diffusing blocks were placed inside the treatment room one day prior to the mixing event, and prior to mixing, sows had no previous exposure to the treatment. The synthetic olfactory agonist contained lipid-soluble compounds found in skin secretions of sows using a formula described by. The diffusing blocks consisted of slow-release macromolecular gelatin composed of water (>90%), non-ionic surfactant (4%) a gelling gum (3%) and the active principle synthetic olfactory agonist (2%). The total weight of the block was 150 g. The diffuser blocks were placed above the concrete flooring on which the sows were fed, and at the height of the ventilation window to ensure maximal circulation of the product (Fig. 1). The treatments were reversed between the two replicates so that in the second replicate, the first room contained the synthetic olfactory agonist and the second room acted as the control. The two replicates were conducted four months apart after washing to ensure the rooms were free of any product residue.

2.3. Experimental design

On day −1, sows were weighed, counted for skin lesions, scored for lameness and a saliva sample was collected. The sows were marked for individual identification using stock marker with a unique symbol and colour combination. On day 0, the sows were mixed into their respective treatment pens. Behaviour was recorded via video cameras, saliva collected and skin lesion counted on days 0, 1, 3 and 7 relative to mixing. At 14:00 h on day 7, the diffuser blocks were removed from the room containing the SOA treatment pens and emergency windows were opened overnight to remove agonist residue. On days 8 and 14 behavioural recordings, saliva samples, and skin lesion counts were collected once more. The experimental period concluded on day 14, and on day 15 sows were weighed and scored for locomotion.

2.4. Behavioural analysis

Each of the four pens were monitored for behaviour of the sows using a digital video recorder (Legria HFR26, Canon, Sydney Australia). On recording days, the four cameras were turned on at 07:00 h before floor feeding commenced. Pens were recorded for six hours, with cameras turned off at 13:00 h. Behavioural analysis of the recordings occurred in Observer XT v10.0 (Noldus Information Technology, Wageningen The Netherlands) and sows were scored for the behaviours outlined in Table 1. Behaviours were scored as mutually exclusive continuous variables, thus each sow had to be performing one of the listed behaviours at any given time. When a sow was observed to be performing the behaviour termed 'aggression', the occurrence of specific point variables (see Table 1 for descriptions) was also recorded. Successive bouts of the same behaviour were scored as two separate events when the interval was greater than 3 s for continuous behavioural states (i.e.

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