Applied Animal Behaviour Science xxx (xxxx) xxx–xxx

Contents lists available at ScienceDirect

Applied Animal Behaviour Science

journal homepage: www.elsevier.com/locate/applanim

Influence of enrichment material and herbal compounds in the behaviour and performance of growing pigs

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ARTICLE INFO

Keywords:
Environmental enrichment
Herbal compounds
Stress
Behaviour
Pigs

ABSTRACT

Pigs reared in barren conditions are exposed to many different stressors, compromising their welfare and producing physiological and behavioural changes. The aim of this study was to assess the effect of environmental enrichment (EE) consisting of natural hemp ropes, sawdust, rubber balls, and a herbal compound (HC) of *Valeriana officinalis* and *Passiflora incarnata* on the behaviour and performance of growing pigs. Fifty-six pigs were used to assess four different treatments divided in two pens of seven animals per treatment (14 pigs/treatment). The treatments tested were: (a) pigs reared with EE, (b) pigs supplemented with HC, (c) pigs provided with both EE and HC, and (d) control group (CG, neither EE nor HC). Body weight and lesions were measured before starting the experiments (week 15) and at 18, 20, 22 and 24 weeks of age. Weekly instantaneous scan and continuous focal sampling were used to record behavioural patterns of activity, social interactions and abnormal behaviours. Three novel tests were carried out at 16, 19 and 23 weeks of age. Body weight at the end of the experiment was found to be significantly lower for the pigs reared in the control group compared to the other treatments ($p = 0.0009$). Furthermore, pigs reared with EE presented less stereotypies ($p = 0.016$) and redirected behaviour (0.0188), but more exploratory behaviour ($p = 0.008$). However, pigs supplemented with HC presented less social interactions ($p = 0.048$), a trend to present less negative social behaviour ($p = 0.09$) and less skin lesions ($P = 0.0433$) than pigs not supplemented. Finally, no remarkable differences were reported in any of the three novel tests. Thus, both EE and HC positively influenced some animal welfare indicators and performance of growing pigs in the present experiment.

1. Introduction

Most of the European pig production is based on intensive farming. Intensification mainly aims at optimising production costs, but it may present some detrimental implications on animal welfare grounds. The interest in animal welfare has globally increased (Sandøe and Simonsen, 1992), driving a higher demand for more "animal friendly" systems. Although the concept of animal welfare allows different interpretations (Mason and Mendl, 1993), it is generally accepted that stress negatively influences animal welfare (Veissier and Boissy, 2007). Stress is often defined as a threat to the homeostasis of the organism (Chrousos and Gold, 1992) that activates a broad range of complex physiological, behavioural and neurological changes (Chrousos, 2009). If this response is prolonged, inadequate, excessive, or there is a failure to cope with the stressor it may produce adverse consequences on the physiology of the organism producing immunological, metabolic, reproductive and behavioural alterations (Möstl and Palme, 2002).

Growing pigs in barren environments are exposed to many stressful factors, with the subsequent negative implications for their welfare and health (Ruis et al., 1997). In fact, a barren environment has been suggested as an important stress factor by itself because pigs present limitations to express their foraging species-specific behaviour, leading to frustration (for a review see: van de Weerd and Day, 2009). Environmental enrichment motivates the exploratory behaviour, which is considered a need for pig's welfare (Studnitz et al., 2007), thus, to provide enrichment material for pigs is one of the strategies to reduce stress.

Another strategy to reduce stress is by means of plants with sedative and tranquilizer properties such as *Valeriana officinalis* and *Passiflora incarnata* (Murphy et al., 2010; Peeters et al., 2004; Soulimani et al., 1997). The mechanism involved in the sedative and anxiolytic properties of *Valeriana officinalis* seems to be mediated by the interaction of Valerian Acid with the γ-Amino butyric acid receptors type A ($GABA_A$). The stimulation of $GABA_A$, opens the permeability of chloride channels, producing neural inhibition (Khom et al., 2007; Murphy et al., 2010). Moreover, different bioactive compounds have been detected in

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http://dx.doi.org/10.1016/j.applanim.2017.06.002
Received 29 November 2016; Received in revised form 28 April 2017; Accepted 6 June 2017

Passiflora incarnata such as flavonoids, maltol, cynogenic glycosides and indole alkaloids, without a consensus regarding the most important one for the sedative properties. Flavonoids, which are beyond the most studied components, have a similar effect to Valerian Acid, increasing the membrane permeability by means of the modulation of $GABA_A$ (for a review see: Miroddi et al., 2013). However, up to the knowledge of the authors, the effect of herbal compounds on welfare in pigs has only been published twice (Peeters et al., 2004, 2006).

Novel object tests are commonly used to assess fear and anxiety (Dalmau et al., 2009), although results are not always consistent and easy to interpret. A higher latency to touch a novel object and less time spent investigating the stimulus have been related with higher levels of anxiety or fear (Murphy et al., 2014). On the other hand, an increased excitability, a quicker approach and longer interactions in front of a novel object have been described in pigs reared in barren conditions compared with pigs reared in enriched conditions (Bracke and Spoolder, 2008; Grandin et al., 1987; Pearce and Paterson, 1993; Stolba and Wood-Gush, 1980).

The aim of this work was to study the effect of environmental enrichment by means of natural hemp ropes, sawdust and rubber balls, and the effect of supplementing the diet with a herbal compound containing Valerian (*Valeriana officinalis)* and May pop (*Passiflora incarnata)* on the behaviour at group level or when confronted to novelty and on other animal-based measures (body weight and skin lesions) in growing pigs. Our hypothesis was that pigs raised in an enriched environment and/or supplemented with these herbal compounds should be less stressed and present less abnormal behaviour, less skin lesions and would grow faster than pigs kept in barren conditions and/or without this supplement in the diet.

2. Materials and methods

2.1. Animals and housing conditions

Fifty-six entire males [(Landrace × Large white) × Pietrain] were used in this experiment which lasted 9 weeks (from 16 to 24 weeks of age). Pigs arrived to the facilities at the age of ten weeks with a mean weight of 25 ± 2.04 kg, and were housed together before starting the experiment. At the age of 16 weeks and a mean weight of 49.8 ± 4.27 kg, pigs were randomly distributed between two different rooms. Each room had four pens of 13.67 m^2 (two on the left and two on the right separated by a corridor), with spindles as walls and partly slatted floor. The stocking density per pen was 1.95 m^2/pig. Food and water were provided *ad libitum* by two hoppers and a single nipple drinker. This distribution allowed to test four treatments in two replicates. Since the aim of this experiment was to study the effect of environmental enrichment and supplementation of an herbal compound, the treatments assessed were as follows: (1) pigs supplemented with both environmental enrichment and herbal compound (named as EEHC pigs from this point), (2) pigs supplemented with environmental enrichment (EE), (3) pigs supplemented with the herbal compound (HC) and (4) control group (CG) consisting of pigs kept in a barren environment and without herbal compound supplementation. The enrichment material consisted of a mixture of two point-source objects (i.e. devices/objects often limited in size and restricted to a single location), natural hemp ropes and rubber balls, in this case; and sawdust, all provided at the same time and during all the experiment. In order to support the sawdust, 1/3 of the slats in the enriched pens were partially covered with polypropylene sticks (Click-in®, Rotenca, Agramunt, Spain), and new sawdust was added every two days. A single rubber ball with a diameter of 15 cm was provided in each enriched pen. Two hemp ropes were hung in the walls of the enriched pens, and were substituted when the length of the rope was shorter than 30 cm. The herbal compound used (Sedafit ESC, Phytosynthèse, Saint-Bonnet de Rochefort, France) contained Valerian (*Valeriana officinalis*) and Maypop (*Passiflora incarnata*) and it was manually added to the food concentrate (2000 mg/kg).

Weight was recorded at the age of 15 (before starting the experiment), 18, 20, 22 and 24 weeks using a cage with a scale (MBWA100 Meier-Brakenberg; GmbH & Co, Germany). Skin lesions were assessed at 15 weeks of age (baseline level), the day after mixing the animals and at 18, 20, 22 and 24 weeks of age taking advantage of the restrain provided by the cage during the weighing procedure. The total amount of lesions in one side of the pig in each one of the five regions (ears, front, middle, hind-quarters and legs) defined in the Welfare Quality® (2009) were recorded, in addition to scoring the animal as 0, 1 and 2 according to the protocol. Furthermore, blood, saliva and hair samples were taken before starting the experiment (15 weeks of age), at the middle (20 weeks of age) and at the end (24 weeks of age) for cortisol, chromogranin A and TNF-α quantification as part of a broader study. The results from physiological indicators have been published elsewhere (Casal et al., *in press*) and will not be reported in this paper. All the procedures carried during this experiment were approved by the IRTA ethical committee.

2.2. Behavioural observations

Instantaneous scan sampling and continuous focal sampling as described in Martin and Bateson (1993) were used to record behaviour. Once per week, during nine weeks, direct observations of each room (4 pens) in sessions of two consecutive hours (11:00–13:00) were carried out by a trained observer. The observations were performed in a specific order to avoid possible differences of time between groups. Scan samplings were taken every ten minute intervals, and focal samplings elapsing six minutes per pen were recorded between two consecutive scan samplings (i.e. instantaneous scan samplings of activity were performed for 1 min at the beginning and end of each observation round and 6 min of focal sampling was performed in between). Thus, each observation day provided a total of 12 scans per animal and 18 min of focal sampling per pen, divided in three periods of six minutes. The behaviours observed according to each observational methodology are summarised in Table 1. A new category named “Exploratory behaviour” was created by grouping the categories “interaction with the pen” and “interaction with the enrichment material”. Twenty minutes before starting the observations, the observer entered into the room and walked for ten minutes among the corridor with the aim of allowing the pigs to get used to his presence. Then, the observer moved to the centre of the room, and stayed there for another ten minutes before starting the observations. Observations were done from the centre of the room with full visual contact to all the pens.

2.3. Novel object tests

At 16 weeks of age pigs were subjected to a novel object test in a novel environment. The novel object was a traffic cone filled with cement to avoid the potential movement produced by pigs when contacting it. A second novel test was performed at 19 weeks of age, and consisted in a PVC ball of 55 cm (Fitball 55 cm Domyos, Decathlon, Villeneuve-d’Ascq, France) suspended from the ceiling at 30 cm from the floor. The pigs did not have previous experience with a hanging ball, as the enrichment material provided was a rubber ball freely available on the floor of different colour, size and texture. Finally, a third novel test was performed with a human shape at 23 weeks of age; the test consisted in a caretaker dressed in a white overall with cowl and with a disposable mask. All the novel tests were performed in the same room. The test room (Fig. 1) was 31.5 m^2 (4.7 m × 6.7 m), and was at a distance of 6.4 m from one of the rooms and at 20.6 m of the other room. In order to balance the distance, a short walk was done with the animals of both treatments before starting the test so that the final time taken to reach the test pen was the same (close to one minute). All pigs were conducted to the test room by the same caretaker. The novel objects were placed straight to the entrance at 3.5 m.