

The influence of aromatized environmental enrichment objects with changeable aromas on the behaviour of weaned piglets

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ABSTRACT

The aim of the study was firstly to check the aroma preferences of pigs, and on the basis of the best results the aromatized environmental enrichment objects were developed. Their effectiveness was tested in relation to aggressive behaviour. In the first stage of the experiment, 24 weaners (crossbreds of Polish Landrace and Polish Large White) were tested for aroma preferences (7 synthetic and natural flavours in perforated hanging containers). The pigs spent more time ($P<0.05$) near natural aromas of moist soil, grass and dried mushrooms, than synthetic vanilla, orange and strawberry aromas. Strawberry was the most popular synthetic fragrance. In the second part of the experiment, 36 weaner crossbreds of PL and PLW were divided into 3 groups, consisting of 12 animals each and were housed in pens: with additional flavoured components (chews - the smell of moist soil), odourless chews and without an additional object. The results showed that pigs used the aromatized objects with natural smells for longer than odourless objects ($P<0.05$) during days 1-9 and day 12. The interest in additional objects decreased with time, whereas the interest in aromatized objects remained at a higher level for the whole duration of the experiment. Changing the aroma after 14 days resulted in a significant rise in interest (time spent with and frequency) in the aromatized toy in comparison to odourless chews (duration 5.99 % vs. 0.23 % and frequency 26.46 vs. 6.07, respectively; $P<0.01$). It suggests that "novelty" is an important characteristic, increasing the attractiveness of an environment enriching object. Duration of agonistic behaviour was lower ($P<0.05$) during days 1-9 in pens equipped with aromatized objects in comparison to other systems.

Key words: pigs, behaviour, environmental enrichment, aromas, aggression

Introduction

Pigs evolved in a partially wooded area, where they had to seek food in the soil. Despite multigenerational genetic selection, pigs still have an intrinsic motivation to explore (FRASER et al., 1991). From the first days of life, young pigs begin to dig,

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bite, sniff and chew objects in the surrounding environment in order to identify which may be suitable for consumption (PETERSEN, 1994). The natural tendency of pigs to explore is particularly evident in an environment poor in stimuli (devoid of enrichment), where manipulative behaviour is directed to the limited number of available objects. In such an environment, the tendency to root and chew is directed at other pigs in the pen (LYONS et al., 1995; KELLY et al., 2000) and its equipment (LYONS et al., 1995). This can lead to aggression, cannibalism (BEATTIE et al., 1995) and tail biting (VAN DE WEERD et al., 2005; SCOTT et al., 2006). According to the Council Directive 2008/120/EC of 18th December 2008, (Council Directive 2008/120/EC laying down minimum standards for the protection of pigs. Official Journal of the European Union L47/5) pigs kept in groups must be prevented from intensive fighting by the usage of large amounts of straw, hay, wood, sawdust, mushroom compost, peat or a mixture of such. Straw acts as a stimulus for investigation and manipulation, and using straw substrate improves the physical comfort of the animals (STUDNITZ et al., 2007). However, most pigs in Europe are kept on a partially or fully slatted floor with no use of straw, and where use of other substrates mentioned in the Directive is difficult. Pig producers are often afraid of additional labour and the diseases prevalent in straw systems (GUY et al., 2013). This is probably the reason why not only straw has been the object of previous studies. It has been found that various types of environmental enrichment can improve the welfare of pigs by providing items enabling handling and exploratory behaviour (AREY, 1993; PETERSEN et al., 1995; BEATTIE et al., 2000; NOWICKI et al., 2007a and 2008; NOWICKI and KLOCEK, 2012). Pigs' exploratory behaviour is best stimulated by the provision of environment enrichment that is odorous, chewable, easy to destroy (VAN DE WEERD et al., 2003; VAN DE WEERD et al., 2005; SCOTT et al., 2006) and edible (VAN DE WEERD et al., 2003). Providing objects for chewing and rooting, which stimulate usage of the snout, can enhance motivation to express exploratory and manipulative behaviour, and therefore decrease the frequency of fights (FRASER et al., 1991; STUDNITZ et al., 2007). It also may affect weight gain in weaners (GREGURIĆ GRAČNER et al., 2013). Nowadays none of currently used "artificial" enrichment on farms offers the opportunity to engage the pig's snout, to stimulate the sense of smell, which is pig's dominant sense (SIGNORET et al., 1975). Olfaction plays an important role in feral pigs, especially when it comes to search and selection of adequate food as well as the social interaction. Pigs are omnivore opportunists with the ability to eat almost any type of food (CRONEY et al., 2003). Due to their highly developed sense of smell, pigs are able to distinguish safe and dangerous foods (KYRIAZAKIS et al., 1990). Moreover, pigs learn very quickly to distinguish the aromas of preferred foods (CAIRNS et al., 2002) from each other, younger individuals learning from their parents (NEWBERRY and WOOD-GUSH, 1985).

As the above data suggest, attractive smells and the susceptibility for deformation and manipulation, are the most important features of enrichment for pigs. Therefore, the

aim of the study was to analyse the odour preferences of pigs, and the possibility of their usage in practice. The second part of the study was to develop a behavioural profile of weaned piglets, housed in a pen equipped with aromatized enrichment objects.

Materials and methods

In the first part of the experiment, 24 piglets, crossbreeds of Polish Landrace (PL) and Polish Large White (PLW), derived from three litters after weaning at 35 days of age, were randomly divided into two groups consisting of 12 individuals each. The pigs were placed in two adjacent pens, sized 2.95×3.18 m, with a concrete floor and a small amount of straw bedding. Weaners were fed ad libitum from the automatic feeder with the compound mixture, and water was available from the nipple drinker. Natural lighting was available, but during the evenings (until 7.30 pm) the artificial lighting was turned on. Experimental animals were marked with specific symbols placed on their backs. Seven perforated plastic containers installed in the ceiling were used in both pens. The first 4 were filled with commercially available aromas: vanilla, strawberry, orange and mint. The remaining 3 containers were filled with grass, dried mushrooms and damp soil. Observations of the behaviour of piglets were carried out using 2 colour industrial surveillance cameras and DVR time-lapse made by BCS. The cameras were installed in the ceiling behind the pens, so it was possible to observe the whole pen area. The experiment started by introducing the piglets to the pen and their behaviour was recorded for two weeks with continuous (24 h) recording. During the observation period the following data were collected: total activity including: frequency of approaching individual containers, the time spent near individual containers, which then made it possible to assess their attractiveness.

In the second phase of the experiment, after selection of the smell most attractive to piglets, 4 enrichment objects were made. Each of these toys consisted of a deformable part made of four flexible chews for babies (Bite&Relax) which resembled the figure "eight". The chews were installed rigidly to the bottom of a triangle metal frame (70 cm of height). A perforated container for the odour substrate was located at the top of the frame, so that the animals did not have direct access to it. The behavioural observations were used to determine the level of aggression in the groups of piglets after weaning in different growing conditions. Therefore, a total of 36 piglets were used, crossbreeds of PL and PLW, weaned at 35th day of rearing. After weaning, piglets from 6 litters were mixed, and then divided into groups consisting of 6 individuals each (3 gilts and 3 barrows), placed in 6 adjacent pens 2.95×2.2 m in size, with a concrete floor and a small amount of straw bedding. The weaners were fed ad libitum from the automatic feeder with compound mixture, and water was available from the nipple drinker. Lighting conditions were the same as in the first stage of the research. Two of the pens were equipped with an additional flavoured object with a pre-selected aroma, suspended at

a height of 35 cm from the ground. Two further pens were equipped with the same but odourless object (empty container). The last two pens were deprived of an environment enriching object. 24-hour continuous observations of behaviour were conducted using 6 colour surveillance cameras, equipped with infrared illuminators and a digital time-lapse recorder (BCS). The cameras were installed in the ceiling behind each of the 6 pens. The behaviour of the piglets was recorded for 9 days from their introduction to the pen. Observations verifying the proper functioning of the objects were repeated on the 12th day after weaning. On the 14th day the aroma in the container was changed for the second most attractive from the first stage, and observation of behaviour was conducted. After the end of the observations, the analysis of the behaviour of piglets was undertaken using ethograms. During the observation, the following data were collected: the length of the activity phase including: duration and frequency of interest in the toy (nose and oral contact with the object), duration and frequency of agonistic behaviour, and the duration of the resting phase, which included: lying laterally and sternally. The data were analysed first using the Kolmogorov-Smirnov test and Lilliefors test to check the data distribution. The differences among mean values were compared using the Kruskal-Wallis test, using Statistica 10 PL software (StatSoft Inc., 2011)

Results

In the first phase of the experiment the frequencies of approaching the containers and the time spent near them were measured. It was found that the most attractive were natural aroma of moist soil and fresh grass was second most preferred and dried mushroom flavour (Table 1). Strawberry was the most popular synthetic aroma. There were statistically significant differences ($P < 0.05$) found in the frequency of approaching the containers, between these four aromas mentioned above and the other three: vanilla, orange and mint, which were less preferred ($P < 0.05$). There were similar statistical differences found in time spent standing near the aroma containers.

Table 1. Smell preferences of weaners, measured by the frequency of contact with aromas and duration of standing near the aroma containers (min.), $n = 24$

| Aroma type | The average daily frequency of contact with aroma container | Mean daily duration of standing near the aroma container (min.) |
|-----------------|---|---|
| Vanilla | 2.42 ^a ± 1.78 | 3.29 ^a ± 1.14 |
| Strawberry | 5.25 ^b ± 1.62 | 5.70 ^b ± 1.04 |
| Orange | 2.59 ^a ± 1.63 | 4.08 ^a ± 1.86 |
| Mint | 2.76 ^a ± 1.24 | 3.79 ^a ± 1.84 |
| Grass | 5.82 ^b ± 0.96 | 13.45 ^c ± 1.02 |
| Dried mushrooms | 5.63 ^b ± 1.77 | 11.75 ^c ± 1.47 |
| Moist soil | 5.97 ^b ± 1.63 | 14.33 ^c ± 1.29 |

a,b - mean values marked in columns with different letters differ statistically significantly ($P < 0.05$)

In the second phase of the experiment, moist soil was used as the filling for the aromatized object. In accordance with the methodology, after 14 days of observation, the containers were refilled with freshly mown grass - the second preferred aroma. In the second stage of the research the duration of agonistic behaviour was statistically significantly shorter ($P < 0.05$) during days 1-9 in pigs with access to aromatized objects, in comparison to the weaners housed without an enrichment object or with an odourless object (Tables 2-4). In the 12th and 14th days of observation the duration of agonistic behaviour did not differ statistically between the experimental groups of weaners (Table 5-6). There was no significant difference found in the frequency of agonistic behaviour between the groups of piglets in pens with aromatized and odourless objects, except on days 3-9 ($P < 0.05$).

A gradual decline in interest in the aromatized object during subsequent days of observation was found. Changing the flavour after 14 days resulted in increased interest in the toy, but there were no significant differences in the frequency of agonistic behaviour between the group housed with an aromatized object and the group with an odourless object (Table 6).

Table 2. Behavioural profile of experimental weaners (24 h = 100 %, frequency in absolute values), 1st day of observation

| Behaviour | Housing system | | |
|---|---|--------------------------------------|-------------------------------------|
| | Pens without enrichment object (n = 12) | Pens with aromatized object (n = 12) | Pens with odourless object (n = 12) |
| Total activity (%) | 48.26 ± 2.54 | 51.43 ± 1.45 | 47.34 ± 2.78 |
| Duration of eating (%) | 14.68 ± 2.27 | 16.88 ± 2.79 | 15.94 ± 3.34 |
| Total rest (%) | 51.74 ± 2.54 | 48.57 ± 1.45 | 52.66 ± 2.78 |
| Duration of agonistic behaviour (%) | 1.23 ^a ± 0.89 | 0.52 ^b ± 0.29 | 1.18 ^a ± 3.21 |
| Frequency of agonistic behaviour | 71.15 ^a ± 4.36 | 32.46 ^b ± 4.15 | 40.67 ^b ± 3.96 |
| Duration of interest in enrichment object (%) | - | 4.58 ^a ± 4.11 | 1.17 ^b ± 0.36 |
| Frequency of interest in enrichment object | - | 54.26 ^a ± 5.24 | 23.89 ^b ± 6.29 |

a,b - mean values marked in lines with different letters differ statistically significantly ($P < 0.05$)

Table 3. Behavioural profile of experimental weaners (24 h = 100 %, frequency in absolute values), 2nd day of observation

| Behaviour | Housing system | | |
|---|---|--------------------------------------|-------------------------------------|
| | Pens without enrichment object (n = 12) | Pens with aromatized object (n = 12) | Pens with odourless object (n = 12) |
| Total activity (%) | 46.32 ± 4.64 | 50.83 ± 2.96 | 45.11 ± 2.62 |
| Duration of eating (%) | 15.63 ± 3.89 | 17.89 ± 3.12 | 15.41 ± 2.57 |
| Total rest (%) | 53.68 ^a ± 4.64 | 49.17 ^b ± 2.96 | 54.89 ^a ± 2.62 |
| Duration of agonistic behaviour (%) | 1.02 ^a ± 3.23 | 0.41 ^b ± 0.36 | 0.88 ^a ± 0.49 |
| Frequency of agonistic behaviour | 60.00 ^A ± 7.26 | 24.36 ^B ± 6.57 | 33.59 ^B ± 2.32 |
| Duration of interest in enrichment object (%) | - | 4.02 ^a ± 1.07 | 2.03 ^b ± 1.78 |
| Frequency of interest in enrichment object | - | 50.83 ± 2.96 | 45.11 ± 2.62 |

a,b - mean values marked in lines with different letters differ statistically significantly (P<0.05); A,B - mean values marked in lines with different letters differ statistically significantly (P<0.01)

Table 4. Behavioural profile of experimental weaners (24 h = 100 %, frequency in absolute values), mean values for days 3-9

| Behaviour | Housing system | | |
|--|---|--------------------------------------|-------------------------------------|
| | Pens without enrichment object (n = 12) | Pens with aromatized object (n = 12) | Pens with odourless object (n = 12) |
| Total activity | 42.18 ± 6.38 | 44.83 ± 7.29 | 39.57 ± 7.72 |
| Duration of eating | 17.68 ± 4.57 | 19.13 ± 4.39 | 18.29 ± 3.18 |
| Total rest | 57.82 ± 6.38 | 55.17 ± 7.29 | 60.45 ± 7.72 |
| Duration of agonistic behaviour | 0.66 ^a ± 0.48 | 0.21 ^b ± 0.04 | 0.58 ^a ± 0.10 |
| Frequency of agonistic behaviour | 14.57 ^a ± 8.85 | 7.27 ^b ± 6.39 | 12.10 ^a ± 9.54 |
| Duration of interest in enrichment object | - | 3.79 ^a ± 2.24 | 1.06 ^b ± 0.56 |
| Frequency of interest in enrichment object | - | 13.56 ± 3.82 | 10.24 ± 3.13 |

a,b - mean values marked in lines with different letters differ statistically significantly (P<0.05)

Table 5. Behavioural profile of experimental weaners (24 h = 100 %, frequency in absolute values), 12th day of observation

| Behaviour | Housing system | | |
|---|---|--------------------------------------|-------------------------------------|
| | Pens without enrichment object (n = 12) | Pens with aromatized object (n = 12) | Pens with odourless object (n = 12) |
| Total activity (%) | 36.86 ± 3.18 | 41.43 ± 3.36 | 38.57 ± 4.19 |
| Duration of eating (%) | 16.04 ± 2.04 | 17.32 ± 1.11 | 18.01 ± 1.23 |
| Total rest (%) | 63.14 ± 3.18 | 58.57 ± 3.36 | 61.43 ± 4.19 |
| Duration of agonistic behaviour (%) | 0.26 ± 0.18 | 0.09 ± 0.05 | 0.12 ± 0.08 |
| Frequency of agonistic behaviour | 6.56 ^a ± 1.15 | 2.02 ^b ± 1.75 | 2.60 ^b ± 1.28 |
| Duration of interest in enrichment object (%) | - | 1.11 ^a ± 0.42 | 0.29 ^b ± 0.17 |
| Frequency of interest in enrichment object | - | 8.47 ^a ± 2.61 | 6.22 ^b ± 1.46 |

a,b - mean values marked in lines with different letters differ statistically significantly (P<0.05); A,B - mean values marked in lines with different letters differ statistically significantly (P<0.01)

Table 6. Behavioural profile of experimental weaners (24 h = 100 %, frequency in absolute values), 14th day of observation

| Behaviour | Housing system | | |
|---|--------------------------------|-----------------------------|----------------------------|
| | Pens without enrichment object | Pens with aromatized object | Pens with odourless object |
| Total activity (%) | 36.56 ± 2.24 | 47.13 ± 3.59 | 35.19 ± 4.27 |
| Duration of eating (%) | 14.22 ± 2.10 | 15.96 ± 2.18 | 16.24 ± 1.48 |
| Total rest (%) | 63.44 ± 2.24 | 52.87 ± 3.59 | 64.81 ± 4.27 |
| Duration of agonistic behaviour (%) | 0.19 ± 0.02 | 0.07 ± 0.04 | 0.09 ± 0.08 |
| Frequency of agonistic behaviour | 5.89 ^a ± 1.15 | 1.05 ^b ± 0.23 | 1.08 ^b ± 0.32 |
| Duration of interest in enrichment object (%) | - | 5.99 ^A ± 2.45 | 0.23 ^B ± 0.09 |
| Frequency of interest in enrichment object | - | 26.46 ^A ± 4.82 | 6.07 ^B ± 3.87 |

a,b - mean values marked in lines with different letters differ statistically significantly (P<0.05); A,B - mean values marked in lines with different letters differ statistically significantly (P<0.01)

Discussion

To date, many experiments regarding behavioural preferences in pigs have been conducted, but it is difficult to find data on aroma preferences of pigs when it comes to environment enriching objects. NOWICKI et al. (2007a), in their experiment, carried out observations of the behaviour of piglets after weaning, held in pens equipped with suspended, flexible and deformable chews, and a hanging wooden ball, without additional components. There were no statistically significant differences in total activity between groups. Statistically significant differences were found in regard to agonistic behaviour. The highest frequency of violence was observed in the group housed in a pen with no additional components. Comparing the data mentioned above with the results of the current study it can be stated that the daily activity of the animals was similar. In this study the animals transmitted their frustration to the suspended elements in their environment, which are more effective in prevention of aggression than artificial enrichment on the floor (COURBOULAY, 2011) because it can be easily soiled with faeces (NEWBERRY, 1995; BRACKE, 2007). Susceptibility to deformation, chewing and eventual destruction (features represented by chews) made enrichment more attractive, which was also noted by STUDNITZ et al. (2007) and VAN DE WEERD and DAY (2009). Another crucial trait of the toy is the “novelty aspect”, which allows animals to express exploratory behaviour (VAN DE WEERD et al., 2003). Novelty seems to be a factor conducive for keeping the attention of pigs (MOINARD et al., 2003). This was confirmed in the current study when the aroma was changed to grass. NOWICKI et al. (2007b) carried out observations of the behaviour of piglets after weaning, in pens equipped with: a suspended wooden, flavoured ball, a suspended wooden ball, and without additional components Their results showed that the enrichment of the environment in the form of flavoured wooden balls resulted in a statistically significant reduction of aggression levels. Although the presence of non-flavoured balls also resulted in less fights it was not confirmed statistically. In the present study, odourless objects resulted in statistically significantly lower frequency of agonistic behaviour in comparison to the pens with no enrichment objects on the 1st, 2nd, 12th and 14th day of observation. The experiment conducted by JANKEVICIUS and WIDOWSKI (2003) showed how surprising pigs’ taste preferences can be. Experimenters installed ropes soaked with water, brine or blood in the pens. In addition, they were also coloured with red food dye. Pigs preferred the taste of blood, not paying attention to the colour. Dye did not play a significant role because pigs have a much better developed sense of smell and taste than vision (HUTSON et al., 1993 and 2000; LOMAS et al., 1998). An additional incentive was the natural scent of blood, which is more familiar and therefore more interesting to pigs than the scent of salt and water. In our own experiment pigs also preferred natural fragrances.

Conclusion

The findings of this study suggest that weaners prefer mostly natural fragrances. Their use in objects suitable for biting can encourage weaned piglets to spend more time showing an interest in such environmental enrichment. It seems that the provision of aromatized objects suitable for biting can reduce the duration of agonistic behaviour in newly mixed weaners. Changing the aroma after 14 days resulted in a significant rise in interest (time spent with and frequency) in the aromatized toy, which suggests that “novelty” is an important characteristic, increasing the attractiveness of an environment enriching object. To stop the loss of interest in the aromatized object, a change in the fragrance is required after several days.

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SAŽETAK

Cilj istraživanja bio je prvo provjeriti sklonost svinja prema određenim mirisima, a zatim na osnovi najboljih rezultata razviti mirišljive predmete za obogaćivanje okoliša. Njihova učinkovitost bila je provjerena u odnosu na agresivno ponašanje svinja. Tijekom prvog dijela istraživanja, kod 24 odbijena praseta (križanaca poljskog landrasa i poljske velike bijele svinje) provjerena je sklonost prema mirisima (7 umjetnih i prirodnih mirisa primijenjenih u visećim probušenim kutijama). Svinje su provele više vremena ($P < 0,05$) uz prirodne mirise vlažnog tla, trave i osušenih gljiva nego uz umjetne mirise vanilije, naranče i jagode. Među umjetnim mirisima najprivlačniji je bio miris jagode. Tijekom drugog dijela istraživanja, odbijena prasada ($n = 36$), križanci poljskog landrasa i poljske velike bijele svinje, bili su podijeljeni u tri skupine po 12 prasadi. Prasad je držana u oborima, pri čemu su jednoj skupini dodani predmeti za žvakanje s mirisom vlažnog tla, drugoj skupini predmeti za žvakanje bez mirisa, a treća skupina nije dobila nikakve predmete. Rezultati su pokazali da su svinje duže koristile, tijekom 1 do 9 dana i 12. dan, predmete s prirodnim mirisom u odnosu na one bez mirisa ($P < 0,05$). Zanimanje za pridodane predmete s vremenom se smanjivalo, no u slučaju predmeta s mirisom ostalo je na višoj razini tijekom cijelog pokusa. Promjena mirisa nakon 14 dana dovela je do značajnog porasta zanimanja (vrijeme boravka i učestalost) za mirisne predmete u odnosu na predmete bez mirisa (vrijeme boravka 5,99 % u odnosu na 0,23 % i učestalost 26,46 u odnosu na 6,07, $P < 0,01$). Navedeno pokazuje da su "novosti" u okolišu važne jer novi predmeti za obogaćivanje okoliša pojačano privlače svinje. Trajanje natjecateljskog ponašanja svinja bilo je kraće za 1 do 9 dana ($P < 0,05$) u oborima opremljenima mirisnim predmetima.

Ključne riječi: svinje, ponašanje, obogaćivanje okoliša, mirisi, agresija
