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RESEARCH ARTICLE

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Pig's behavioral response in nursery and growth phases to environmental enrichment objects

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Abstract

The objective of this research was to evaluate the effect of environmental enrichment on the behavior of pigs in nursery and growth phases. (i) Ninety animals (females, 65 days, 25 kg) were divided into three treatments (T1- Pen enriched with objects made of destructible material by the animal, T2- Pen enriched with objects made of non-destructible material by the animal, T3- Pen without environmental enrichment objects - control treatment) - in a completely randomized design and reference of the animals by objects of enrichment of different colors (red, blue or yellow). (ii) males, 25 days old, 7 kg were distributed in a completely randomized design with four treatments (cloves, garlic, alternating aromas and absence of control smells) and six replicates each. (iii) determine the appropriate ratio between the number of enrichment objects and the animals present in the animals (n = 138; females; 65 days; 25 kg) were distributed in three treatments, in a completely randomized experimental design (proportion of one enrichment object for each 1511 animals or 9 animals, respectively). Environmental enrichment objects made from destructible materials are more attractive to pigs. No preference for pigs for environmental enrichment objects of specific colors was observed. Environmental enrichment objects with garlic aroma had a repellent effect. No effect was observed of alternating perfumes in the animals retaining interest in the objects since the smell of garlic acted as a repellent. Thus, the proportion of one enrichment object for each 15 pigs is sufficient to avoid problems of dispute between the animals.

Additional keywords: colour preference; olfaction; preference, sight; welfare.

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Introduction

In face of new demands of the international market and changes in meat-consumer profile, pig farmers must adapt their production systems to improve animal well-being. When pigs are not able to exert their natural behavior, they target their investigative behavior to explore the confinement environment and the other animals in the pen (Kelly *et al.*, 2000; Scott *et al.*, 2006).

Although studies have shown that pigs prefer substrates to toys (Van de Weerd *et al.*, 2003; Scott *et al.*, 2007; Elmore *et al.*, 2012), using toys as enrichment in pig farming has proven quite promising. The efficacy and success of any type of environmental enrichment depends on its capacity of stimulating a certain behavior typical of the species. Some studies show that materials that were destructible, variable, complex, interactive, and had edible parts induce behaviors typical of pigs (Van de Weerd *et al.*, 2003). Pigs are intelligent, highly curious animals, which lose interest in objects within a short time (Trickett *et al.*, 2009). Thus, several factors must be taken into account when choosing environmental enrichment so that it appropriately serves its purposes for a long time. Pigs have very keen senses; thus, sensorial stimuli can be alternatives to

prolong duration of interest by the animals in objects of environmental enrichment.

The way pigs differentiate colors has not been clearly described in the literature. According to Klopfer (1966), pigs are able to differentiate wavelengths between 575 nm and 590 nm and between 620 nm and 680 nm, comprising the colors yellow (565-590 nm) and red (625-740 nm) colors. In a study by Neitz & Jacobs (1989), the wavelengths identified for this species ranges from 439 to 556 nm, including blue (440-490 nm).

Therefore, this study has three objectives: (i) to determine the preference of pigs in the growth phases for environmental enrichment objects of different materials and colours; (ii) to assess the influence of different scents on the acceptance of those objects by pigs in the nursery phase, including the ability to extend the animals' interest in them and (iii) to evaluate the ratio number of animals and number of objects.

Material and methods

The research complied with ethical standards and was approved by the Ethics Committee on Animal Use (permit 29/2013 and 06/2015) of the Federal University of Grande Dourados, CEUA-UFGD. The trials were carried out in a commercial pig farm in the city of Dourados, MS, Brazil.

The Trials 1 and 2 employed 90 pigs of the same lineage (DB – DanBred; females; initial age of 65 days old and 25± 2 kg). The pigs were housed (30 animals/pen) in a conventional masonry barn 5.83 m long, 4.0 m wide (0,78 m^2/pig), and 4.0 m tall on the east-west axis featuring corrugated fiber cement tile roof, concrete floors, and side curtains. The 24.0 m^2 pens had concrete floors in the frontal area and a shallow pool in the back, besides semi-automatic feeding troughs and nipple drinking troughs. The water and food were provided *ad libitum*. Shallow pool are structures located at the end of the pen, with greater slope than the rest of the floor and are filled with water. The mean temperature and humidity in the experimental period were 19.6°C and 83.74%, respectively.

Trial 1

This trial was carried out to determine the pigs' preference for different materials (destructible or non-destructible by the animal) in the enrichment object. The animals (n = 90; females) were assigned to three treatments in a completely randomized design with 30 animals per treatment: T1, pen enriched with objects made of material destructible by the animal; T2, pen enriched with objects made of material non-destructible by the animal; and T3, pen with no environmental enrichment objects (control treatment).

The enrichment objects considered destructible were made up of a chain of polyethylene plastic links, while the non-destructible objects were rings 10 cm in diameter made of sturdy rubber. Three objects were placed in each pen (Fig. 1).

After three days of animal adaptation to the experimental facilities, the enrichment objects were placed in the pens and the behavioral analyses began, taking place for 8 h/day on three consecutive days. The objects were hung vertically in the pens at the pigs' eye height to facilitate visual contact. Five animals per treatment were randomly selected to build the frequency histogram of the behavioral activities listed in the ethogram (Table 1). The animals received identification on the dorsal region with a crayon marker and each one was considered an experimental unit.

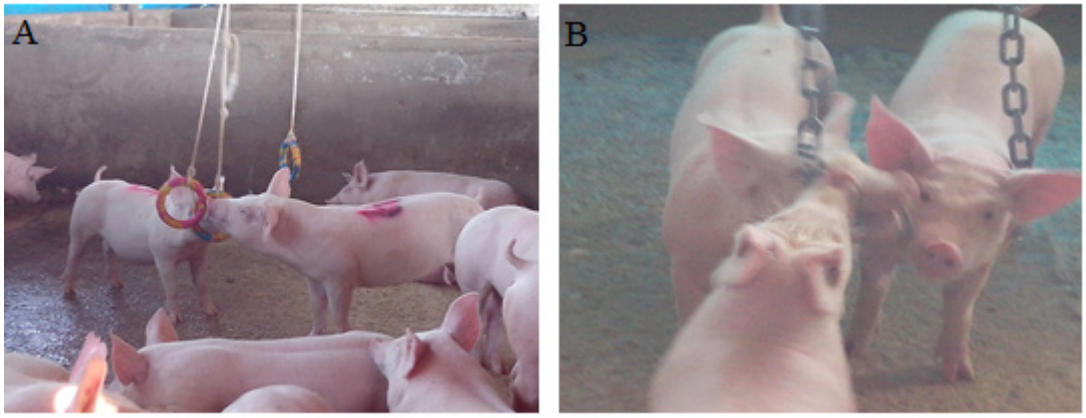

Figure 1. Environmental enrichment objects provided to the pigs: non-destructible objects, chain of polyethylene plastic links (A) and destructible objects, rings made of sturdy rubber (B).

Table 1. Ethogram used to assess the behavior of pigs with the presence of environmental enrichment objects.

Behavior	Description
Interacting with object (IO)	Interaction with the object: sniffing, biting, pushing, chewing, nuzzling.
Sleeping (S)	Pig lying with eyes closed.
Idling (I)	Pig standing idle while performing no activity. Pig lying awake and immobile.
Eating or drinking (E/D)	Pig with the head in the feeding/drinking trough ingesting feed/water.
Nuzzling another pig or the pen (NO/NP)	Nuzzling or nibbling on the year, tail, belly, or another part of the body of another pig or any part of the pen.
Agonistic behavior (AB)	Fighting, biting, or scratching other pigs. Fights, aggressiveness, and fleeing.
Others	Any other behavior not described above (*e.g.*: defecating, urinating, moving around).

In order to assess the number of times the environmental enrichment object was accessed and the total time of interaction with them, all animals present in each pen were considered (n = 30). The incidence of agonistic behaviors was determined, *i.e.*, any behavior related to fights, involving exhibitions, fleeing, fighting, biting, and scratching among the pigs. Agonistic behaviors were defined here as any aggressive interaction involving one or more pigs (fights, disputes, chase and flight, head-banging).

Trial 2

The second trial was carried out to determine the animals' preference for enrichment objects of different colors (red, blue, or yellow). The animals (n = 90) at 109 days old and with mean initial weight of 60 ± 2 kg were randomly assigned to three pens with 30 animals per pen. The objects, made with nylon ropes fastened to a metallic gutter rail, were hung at the animals' eye height. Each pen had one object of each color for a total of three objects per pen (Fig. 2).

In this trial, behavioral analyses were performed for three consecutive days for eight straight hours. The influence of time (days) on the number of accesses and the total time of interaction with the objects was also assessed. For this analysis, each day of the experimental period was considered a treatment and there were three repetitions for each object color.

Trial 3

Twenty-four animals of the same genetics (Landrace x Large White; males) with initial age of 25 days and mean initial weight of approx. 7.0 kg ± 1 were used. The piglets were housed in a nursery with elevated metallic pens 1.0 m × 1.75 m equipped with feeding troughs and nipple drinking troughs. Six animals were housed in each pen for an occupation rate of 0.3 m²/animal. All animals were subjected to the same management and feeding conditions during the experimental period.

The animals were assigned to four treatments in a completely randomized experimental design with six repetitions per treatment, with each animal being considered an experimental unit.

The treatments were T1 (enrichment object scented with clove essence), T2 (enrichment object scented with garlic essence), T3 (enrichment object scented with clove and garlic essences alternated every other day), and T4 (unscented enrichment object, control).

The objects were made with a PVC structure featuring four lengths of plastic tubing with holes (Fig. 3). Inside each object, there was a compartment that contained each of the essences used and each length

Figure 2. Environmental enrichment objects of different colors (red, blue and yellow). The objects were made with nylon ropes fastened to a metallic gutter rail.

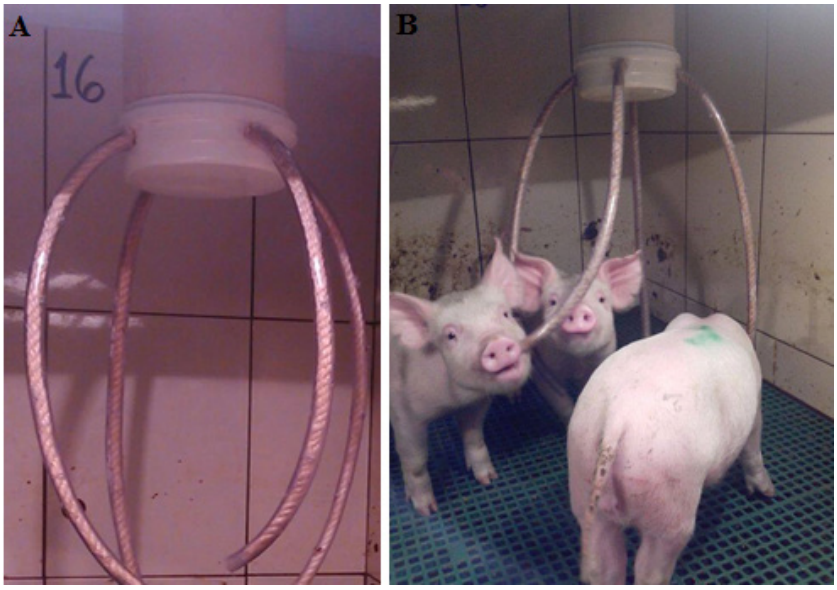

Figure 3. Environmental enrichment object (A) and pigs interacting with the object (B). The environmental enrichment objects were made up of a PVC pipe with four pieces of transparent plastic tubing.

of tubing had lengths of sisal rope inside that absorbed the essence stored in the PVC pipe and the scent was exhaled through the holes in the tubings. The essences inside the PVC structure were replenished daily so that they did not contact the animals. The objects (one per pen) were hung at the pigs' eye height to facilitate visual contact. Four objects were made and each one contained only one essence.

The experiment lasted 13 days, 7 days being used to adapt the animals to the experimental facilities and to establish a social hierarchy after mixing piglets from different post-weaning lots. The other 6 days were used for behavior assessments. The following were assessed: the animals' behavior through an ethogram (Table 1), the number of accesses to the environmental enrichment object, and the total time of interaction with the objects.

Behavior analyses (Trials 1, 2 and 3)

Behavior was assessed using direct observation by the same three observers, who recorded in a spreadsheet the number of the animal and the respective activities every 10 min for 8 straight hours on each day (between 7:30 a.m. and 3:30 p.m.). The observers underwent training and stood in the hallways of the barn in order to minimize their interference with the animals' behavior. Prior to the start of the observations the observers had 30 min for adaptation.

The observations were used to create a histogram that characterized the proportions of time dedicated to each behavior in the ethogram (Table 1). Besides the ethogram assessment, whenever any of the objects received interaction from any animal in the pen, one access was counted. For each access, the time during which the animal interacted with it was measured. All animals in each pen (n = 30) were used to compute the total time of interaction with the objects the animals were not individually identified; this variable was calculated by adding up the time of interaction of all animals in the treatment and dividing this value by the number of animals observed in order to obtain the mean time of interaction per animal.

Trial 4

The study used 138 female pigs, all of the same commercial lineage (DB = DanBred; females; initial age of 65 days old and 25 ± 2 kg). The animals were housed in in 60.0 m^2 pens (1.3 m^2/pig) on a conventional masonry barn 100 m long, 8.0 m wide, and 8.0 m height on the east-west axis featuring corrugated fiber cement tile roof and side curtains. The pens had concrete floors in the front area, a shallow pool in the back, semi-automatic feeding troughs and nipple drinkers troughs. The pigs were assigned to three treatments in a completely randomized design with 46 animals per treatment in the same pen. The treatments were: 1) Ratio of one enrichment object for every 15 animals; 2) Ratio of one enrichment object for every 11 animals; 3) Ratio of one enrichment object for every 9 animals.

The animals remained three days adapting to the facilities and the experimental evaluations began when they were 68 days old. The environmental enrichment objects were made up of a PVC pipe 25 cm long and 20

cm in diameter with four pieces of transparent plastic tubing 65 cm long. A sisal rope was placed inside each length of tubing in order to absorb the impact of bites from the animals so that they could not be torn apart. The objects were hung at the pigs' eye height to facilitate visual contact (Fig. 4) and the distance between the objects was around 2 m.

Behavior analyses (Trial 4)

Behavior was analyzed using images recorded by video cameras (DVR H264 model) installed on the top of the pens and directly connected to a device with an image capture card and LCD monitor. One camera was installed in each pen. The images were recorded for six consecutive days from 7:10 a.m. to 3:10 p.m. for a total of 8 h of recording per day of assessment. The videos were stored in the internal memory of the monitoring equipment for later evaluation.

The behavioral assessment used an ethogram (Table 1) developed according to the methodology proposed by Pandorfi *et al.* (2006) and Campos *et al.* (2010). The frequency of behavioral activities listed in the ethogram was determined by watching the video in the software CyberLink and diving the recording every 10 min, completing 48 events per day (480 min of video recording per day). Since the trials were carried out on a commercial farm, the experiments were done with the minimum interference in the general management generating a limitation to perform the tests during the day.

Figure 4. Environmental enrichment object. The environmental enrichment objects were made up of a PVC pipe with four pieces of transparent plastic tubing.

Statistical analyses

For the behavior analyses, the frequency of each behavior in the ethogram was determined. Data normality was verified using Shapiro-Wilk test and analysis of variance (ANOVA) was performed with the software Assistat.

For the analyses of the time of interaction with the object and the number of accesses, each pen was considered an experimental unit. ANOVA was applied to the data and the means were compared by Tukey's test using the software Assistat.

Results

Trial 1

Respect to time of access to the objects, disregarding the time the animals remained interacting with them, it was verified that the non-destructible materials presented a higher frequency ($p<0.01$) of access (n = 232) in relation to the destructible materials (n = 135). However, no difference ($p>0.05$) was found in the total time of interaction. On average, each pig interacted for 12.1 min daily with the plastic chains and 12.2 min with the rubber rings. Irrespective of the object's material, no effect was observed on the incidence of agonistic behaviors compared to the control treatment, which had no objects in the pen (Table 2).

The occurrence of aggressive behaviors was similar in all treatments, which suggests that the presence of rings and chains was not effective in reducing undesirable behaviors. The frequency of interaction with either object decreased as the days went by, which

Table 2. Mean (±SD) incidence of agonistic behaviors during the three days of observation of piglets in an environment with no environmental enrichment and in an environment enriched with objects of different characteristics.

Treatment	Agonistic behavior
Environment enriched with an object non-destructible by the animal	15 ± 6.65
Environment enriched with an object destructible by the animal	28 ± 6.34
Environment with no enrichment object (control)	25 ± 8.25

shows that, once the pig is familiarized with the object, it ceases to be attractive.

The frequency of the behaviors observed was similar in all three treatments. Overall, the pigs remained inactive, sleeping, or idle for most of the day, which suggests the presence of the environmental enrichment objects did not impact the behavior expected for pigs in this phase.

Trial 2

No difference was found in the number of accesses or duration of interaction with the objects of different colors (Table 3).

The number of accesses and duration of interaction with blue objects gradually decreased over the three days of assessment (Table 4). These results may suggest that those objects became less attractive more quickly, which made them less interesting to the pigs in the growth phase. No difference was observed in the number of accesses or time of interaction with the toys of difference colors over the three days of assessment. Similarly to in Trial 1, the pigs spent most of the day inactive, sleeping, or idle and interacted with the enrichment objects for about 12% of the time (average of 3.5% for each color object).

Table 3. Mean (±SD) number of daily accesses and mean time of interaction of pigs with environmental enrichment objects of different colors.

Object	Mean number of accesses	Mean time of interaction (min/animal)
Blue	77 ± 37	6.28 ± 4.9
Yellow	93 ± 59	6.10 ± 3.9
Red	101 ± 52	7.02 ± 4.0

Table 4. Mean number of daily accesses and mean time of interaction of pigs, with environmental enrichment objects of different colors on the three days of assessment.

	Blue	Yellow	Red	Significance
	Mean time of interaction (min/animal)			
Day 1	12.7 a ± 1	9.2 ± 2	7.2 ± 4	NS
Day 2	3.9 b ± 2	5.2 ± 4	5.9 ± 2	NS
Day 3	7.9 b ± 1	3.9 ± 3	7.0 ± 5	NS
Significance	**	NS	NS	
	Mean number of accesses			
Day 1	118 a ± 17	141 ± 58	138 ± 45	NS
Day 2	65 ab ± 21	82 ± 38	83 ± 12	NS
Day 3	47 b ± 25	55 ± 42	82 ± 61	NS
Significance	*	NS	NS	

*level of significance 1%; **level of significance 5%; NS = not significant.

Trial 3

Overall, the pigs slept for most of the day (average of 55.38%). However, animals provided with objects with no scent on enrichment object or with clove scent spent less time sleeping compared to the others. The animals in the control treatment spend the largest percentage of time interacting with the object. The treatments with clove scent and alternate scents had an intermediate percentage of interaction with the object and with garlic scent had the lowest frequency of interaction. The different aromas did not impact the behaviors of eating and drinking or of nuzzling the other animals or the pen (Table 5). In this context, objects with garlic scent did not encourage use of the enrichment, since they acted as repellant.

It is suggested that, compared to the control object, clove scent as not attractive, but as more attractive than the garlic scent as demonstrated in the alternative treatment (Table 6).

An effect was found of the different scents on the number of accesses to the objects. Clove-scented or unscented objects were accessed more compare to objects with alternate scents and with garlic scent. Regarding the total time, the pigs spent interacting with the environmental enrichment objects, more time was dedicated to the clove-scented objects and objects with alternate scents compared to the treatment with exclusively garlic scent ($p<0.01$). This comparable use, incorporating garlic is explained by the increase in use on the clove scented days. Animals in the control treatment showed intermediate time of interaction, which did not differ from the others (Table 7).

Trial 4

The ratio between the number of objects and the number of animals in the group did not impact ($p>0.05$) the animals' behavioral repertoire (Table 8). The frequency of the behaviors observed was similar in all three treatments. The animals spent approx. 6% of the time on average nuzzling and exploring the environment. The incidence of agonistic behaviors was similar in all three treatments, which suggests the ratio of one object for every 15 animals in the group was adequate and enough to prevent disputes among the animals for the enrichment object.

The observers noted that the characteristics of the toys, such as the flexibility of the plastic tubing, which allows them to be chewed, were very attractive to the animals given the average time (17.2%) the pigs spent interacting with the objects during the experimental period, which is above the time spent visiting the feeding troughs and drinking troughs (9.3%). Nevertheless, the

Table 5. Effect of the different scents on the percentage of time pigs spent in different behavior categories.

Behaviors	Treatments			
	Clove	Alternate	Garlic	Control
Idling	9.2a ± 2.36	6.29ab ± 3.81	2.15b ± 2.68	2.15b ± 1.50
Sleeping	52.89a ± 5.09	57.14ab ± 5.08	61.50a ± 4.77	50.00b ± 2.88
NO/NP	14.51 ± 6.64	15.36 ± 4.97	14.02 ± 4.08	17.97 ± 4.77
E/D	13.20 ± 5.38	14.80 ± 4.17	17.57 ± 5.23	18.16 ± 4.51
IO	9.24ab ± 2.58	5.56bc ± 1.29	3.57c ± 2.37	10.14a ± 2.78
Others	0.96 ± 0.69	0.85 ± 0.53	1.19 ± 0.53	1.58 ± 1.34
Total	100	100	100	100

NO/NP = Nuzzling another pig or the pen; E/D = eating or drinking; IO = interacting with the object. [a, b, c] in the rows differ for $p<0.05$.

Table 6. Number of accesses and mean time of interaction of pigs with objects of alternate scents over the six days of observation.

Variable	Day 1 (Clove)	Day 2 (Garlic)	Day 3 (Clove)	Day 4 (Garlic)	Day 5 (Clove)	Day 6 (Garlic)	Mean	
							(Clove)	(Garlic)
Number of accesses	126	45	82	48	73	45	94a ± 22.5	43b ± 1.41
Time (min/animal)	24.1	12.3	29	8.3	26.6	15.8	26.6a ± 2	12.1b ± 3

animals' interest in interacting with the toys decreased over the six days of the trial, particularly at higher ratios between animals and objects.

Discussion

Overall, the pigs spent most of the day resting, a result that was already expected since pigs in confined environments tend to spend most of the day sleeping or idle (Broom & Fraser, 2010). According to Wood-Gush & Beilharz (1983) the greater amount of inactive behaviors, observed in pigs kept in barren environments, may protect them from the lack of stimulation. This lack of stimulation of species-specific behavior suggests poor welfare and may precipitate re directed behaviors such as tail biting and stereotypies. In a semi-natural environment pigs spend 52% of the day nuzzling and grazing and 23% of the time investigating the environment (Grandin & Jonhson, 2009), therefore the results indicate a lack of stimulus in the confined environment.

Table 7. Mean time spent daily by pigs interacting with environmental enrichment objects with different scents.

Treatment	Time (min/animal)	Mean number of accesses
Clove	21.67 a ± 6.73	95 a ± 25
Control	16.67 ab ± 3.95	74 a ± 12
Garlic	6.83 b ± 5.21	19 b ± 10
Alternate	19.17 a ± 7.49	35 b ± 28

[a,b] in the lines differ for $p<0.05$.

Those results of Trial 1 may be related to the materials' destructibility. The rubber rings were sturdier than the plastic chains, which made manipulating the former more difficult and did not allow them to be destroyed, thus leading the pigs to repeat the interaction with them for a greater number of times. However, they lost interest in this interaction more quickly than when they were able to partially destroy the object, which occurred with the plastic chains. In this study, the subtle difference in interactions with objects is probably due to the fact that the rubber ring and plastic chains have similar materials. Although the plastic chain is more easily destroyed by pigs, its structure did not in fact be attractive to animals.

In the present research, regardless of the trial, the incidence of undesirable behaviors was low. That may be because, irrespective of the treatment, the time spent interacting with the objects was relatively high compared to the other activities performed during the day. That was the second most expressed behavior after sleeping/resting. Moreover, in this study the complexity of the environment made available to pigs, represented by the environmental enrichment objects, the presence of shallow pool and greater space allowance, may have contributed to improve the welfare of pigs. The low frequency may also be explained by the fact the animals diverted much of their time from the exploratory and curiosity behavior (approx. 17% of the overall time) to interacting with

Table 8. Behavioral frequency (%) of female pigs in growth in an environment enriched with different ratios of objects to pigs.

Behavior[1]	15:1	11:1	9:1
SL	69.25 ± 12.9	66.10 ± 4.6	65.03 ± 5.7
IO	16.94 ± 7.8	15.22 ± 4.4	19.40 ± 3.1
ED	8.09 ± 4.4	11.33 ± 1.48	9.05± 3.3
NE	4.97 ± 2.5	6.33 ± 3.3	6.04 ± 1.9
MS	0.62 ± 0.5	0.30 ± 0.4	0.32 ± 0.1
SB	0.04 ± 0.02	0.14 ± 0.1	0.10 ± 0.1
AB	0.06 ± 0.02	0.00	0.02 ± 0.01
IP	0.03 ± 0.01	0.58 ± 0.1	0.04 ± 0.01
Total	100	100	100

[1] SL: sleeping or lying. IO: interacting with the object. ED: eating or drinking. NE: nuzzling or exploring the environment. MS: moving around or sitting. SB: sexual behavior. AB: agonistic behavior. IP: interacting with another pig.

the enrichment object, which shortened the time spent nuzzling, an activity exclusive of pigs.

Our results are in agreement with Paiano *et al.* (2007) and Biazzi *et al.* (2014), who reported that using the shallow pool in the pen reduces undesirable behaviors such as aggressiveness and stereotypy. On the other hand, the studies of Beattie *et al.* (1996) and Turner *et al.* (2000) suggested that the amount of space is not decisive for the behavior of pigs.

Several researchers have studied the effects of environmental enrichment on the incidence of agonistic behaviors among pigs. Schaefer *et al.* (1990) and Ishiwata *et al.* (2002) reported that providing objects decreased the incidence of aggression among pigs. In another of their studies, Ishiwata *et al.* (2004) found that as environmental enrichment was not effective in reducing such behaviors. Beattie *et al.* (2000) reported that pigs in enriched environments spent about 25% of the time in a behavior towards the substrate on the floor. Animals in a barren environment, spent more time exploring static objects in the pen and were more involved in deleterious social behaviors.

The results of the present research show that scents may promote or discourage enrichment use, thus care must be employed when choosing the scent to be used. Despite promoting use compared to garlic, clove scent was not effective in increasing the attractiveness of enrichment compared to the control object. It is known that olfaction is well developed in pigs, hence it is important to establish which are pleasant aromas for them.

The influence of scents on the acceptance of an object was studied by Van de Weerd *et al.* (2003). They reported that the pig attraction towards a toy with malleable characteristic increased when it was scented. The positive effect of scented objects was also found by Nowicki *et al.* (2007). They later suggested (Nowicki & Klocek, 2012) that the use of vanilla-scented objects was the most attractive compared to a barren environment. However, it was more effective on the first day of exposure to the toy, losing effectiveness by the fifth day it was available.

In natural conditions, pigs spend much of their time searching for food, so it is possible that the use of natural aromas further enhance the occurrence of exploratory behavior. This fact was observed by Nowicki *et al.* (2015). The authors compared the interest of pigs with different scents (vanilla, strawberry, orange, rmint, grass, mushrooms and moist soil), noting the preference for natural aromas (moist soil and mushrooms). In this same study, the authors observed the maintenance in the degree of interest enrichment object with the alternation of the aromas of the toys after 14 days.

When assessing four different enrichment materials for pigs in growth (sisal rope, metal chain, sawdust, and wood shavings), Guy *et al.* (2013) found that, regardless of the material, the time the animals spent interacting with the objects decreased over the experiment, as did the level of interaction with the items when the animals were presented with a second combination.

The finding that animals lose the interest more quickly in the blue object might be explained, by pigs seeing the color blue differently to other spectrums. Thus, the color may attract their attention more in the introductory days compared to objects of other colors, but this is only a hypothesis since there is no consensus in the literature concerning pigs' visual capacity on color.

Jankevicius & Widowski (2003) found no influence of color on the acceptance of the object offered to pigs. They suggest that pigs use olfactory or taste characteristics to choose objects, but not colors. However, Stelios *et al.* (2006), when testing the influence of color on the preference of drinking troughs, found that pigs were attracted to objects in red or blue, but ignored the green color.

In summary, environmental enrichment objects made with materials destructible by the animals are more attractive to pigs; no influence of colors could be found on the acceptance of environmental enrichment objects; no effect of alternating scents was observed on the animals maintaining interest in the objects since the garlic scent acted as a repellent. The ratio of one enrichment object for every 15 animals is enough to prevent disputes towards the objects. The characteristics (destructibility, and other sensory properties) of the enrichment object are important factors for its successful use and further research is required into the usefulness of scents in promoting use of enrichment and reducing aggressive behavior.

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