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Auditory Sensory Enrichment (Music) Applied for Growing Phase Swine

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ABSTRACT

In recent years, animal welfare has been discussed with great frequency by media and the scientific area. Among the different types of studies in the area animal welfare, the research about environmental enrichment techniques has stood out as a how a strategy to improve the welfare of different types of animals. The use of music as a sensory stimulus for animals can be a way to enrich the environment and mitigate abnormal behaviors, providing welfare. Thus, the objective of the study was to analyze the influence of auditory sensory enrichment (music) on growing-phase pigs' production, assessing the welfare, behavior and productive performance. The experiment was carried out in the southeastern region of Brazil, in the city of Piracicaba-SP with coordinates of latitude 22º 43 '31 "S and longitude 47º 38' 57" W, during the month of March 2016, with a randomized block design, two treatments and fifteen replicates. Eighteen pigs were randomly housed in two pens, one called control pen (without music) and the other treatment pen (with music), with data collected at 9 a.m. (morning period) and at 4 p.m. (afternoon period). Music influenced the following behaviors: animal interaction, lay/sleep, drink and urinate. After analyzed the results of this research, is possible conclude that there is a tendency for auditory sensory enrichment (music) to have a positive influence in some behaviors in the production of pigs in the growing phase.

INTRODUCTION

In recent years, animal welfare has been discussed with great frequency by media and the scientific area. Among the different types of studies in the area animal welfare, the research about environmental enrichment techniques has stood out as a how a strategy to improve the welfare of different types of animals. The environmental enrichment is an improvement in biological functioning process of animals raised in closed production systems, based on changes in the environment in which they live (NEWBERRY, 1995; PEDERSEN e FORKMAN, 2019). According to Silva (2016), environmental enrichment can be divided into five different types: I) Physic; II) Sensory; III) Cognitive; IV) Social and V) Food.

The sensory enrichment, according Silva (2016), consist in stimulate the five sense of animals, introducing, for example, sounds and vocalizations sounds. The enrichments linked with sense of hearing can be describe as auditory sensory enrichment. In recent decades, scientific articles has search to use different types of sounds (present between this sounds, the music) how a method of enrichment for different animals (WELLS, 2009). This type of enrichment may be interesting for commercial pig production scales because has um low acquisition cost with an easy process of implantation in farms.

The use of music as a sensory stimulus for animals can be a way to enrich the environment and mitigate abnormal behaviors, providing welfare. Despite a few studies for swine, there are scientific findings relevant to human welfare and pet animals (MOREIRA, 2012).

There is some scientific articles show that the insert music for animals can be positive because can generate gains of well-being and/or better productive performance (ALWORTH et al., 2013; DÁVILA et al., 2011; JONGE et al., 2008; SILVA et al., 2017).

Caution is required when choosing the type of music to be used in therapies to not interfere in a negative way on the animal. In a research, Kogan et al. (2012) exposed different groups of dogs kept in a kennel to classical music and *heavy metal*. Kogan et al. (2012) noted that classical music decreased stereotypical behaviors (vocalization, lick and tremors) and increased sleep time and tranquility, while the *heavy metal* favored the incidence of tremors, characteristic of nervousness.

Other study with dogs, suggested the technical capability that classical music has as sensory enrichment. In a rescue center, the dogs staying most of the time lying, sitting and quiet, when listen to classical music (BOWMAN et al., 2015).

Environmental enrichment can be understood as a technique that helps positively the welfare of animals by altering and controlling their habitat with the purpose of preserving the natural behavior of the species. It may be regarded as a type of management, as soon as it favors the quality of life of the confined animals through of improvements in the productive system that benefit the psychological and physiological factors and the ethological needs of each species (NEWBERRY, 1995; CAMPOS et al., 2010).

The most widely used method for evaluating the efficiency of enrichment in the production system is the animal behavior through ethogram (VAN de WEERD et al., 2003; ZWICKER et al., 2013). It is also possible to use other variables such as neurological, physiological, productive and sanitary (DAY et al., 2008; CAMPOS et al., 2010).

While there is little scientific research on the influence of sensory environmental enrichment, reports of pig producers indicate that the use of music soothes animals, facilitates management and decreases productive losses (MAIA et al., 2013).

Enriching the environment in order to improve the welfare of pigs can be a way to generate productive gains from breeders and meet the requirements of consumers concerned with the animal production systems.

The activity of pig farming is of great importance in global agri-business. According to the United States Department of Agriculture, pig meat is the most consumed meat on the planet. The world's largest producers of pig meat are China, European Union, United States, Brazil and Russia (USDA, 2020).

Thus, the objective of the study was to analyze the influence of auditory sensory enrichment (music) on growing-phase pigs' production, assessing the welfare, behavior and productive performance.

MATERIALS AND METHODS

The use of animals for this research has been approved by the Ethics Committee in the Use of Animals (CEUA) with protocol 2015-4 and experiment conducted in the southeast region of

Brazil, in the city of Piracicaba-SP with coordinates of latitude 22º 43' 31"S and longitude 47º 38' 57" W, in March of 2016 and with duration of 15 days, at 9 a.m. and 4 p.m.

Two pens with compact concrete floor were used, measuring 27 square meters (m^2), equipped with a 0.60 x 1.20 meters (m) concrete feeder and an automatic drinker fixed on the wall. By raffle, an acoustic box was added in the pen located on the right side. This pen was called treatment pen (with sensory agent music) and the other pen was called control pen (without sensory agent).

With the use of a non-toxic marker, 18 growing pigs with average age of 63 days and average weight of 22 kilograms (kg) were identified on the back and randomly and equally divided in the pens one day before the beginning of the study. Figure 1 show layout used for experiment.

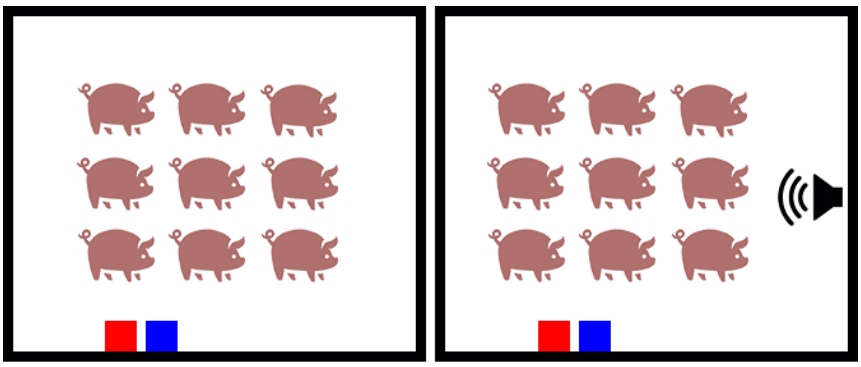

Figure No. 1: Layout of experiment

For 15 minutes (min) of the analyzed hour (9 a.m. to 9:15 a.m. and 4 p.m. to 4:15 p.m.), Bach's classical music (cello Suite No. 1-Prelude) was played in the treatment pen with the appropriate volume to not be heard by the pigs that were in the control pen. In a preliminary analysis, both the control and the treatment pens were divided into 12 quadrants of 1.5 m x 1.5 m.

Simultaneously in each pen and for one minute (min) per quadrant, the sound intensity was collected in decibels (dB) that were transferred to a computational program for subsequent analysis. The choice of music was based on previous research with the same animal species (JONGE et al., 2008). The behaviors were counted through the scanning method on both pens through the elaboration of anethogram (Table No. 1) according to previous researches (JONGE et al., 2008; AHMAD et al., 2011; KAMMERSGAARD et al., 2011).

Table No. 1: Ethogram of behaviors observed during research

ETHOGRAM	
Behaviors	**Description**
Agonistic	Fights: social conflict, assault with bites and shoving Persecution: threat and fugue among animals
Stereotyped	Aerophagia: abnormal movements with tongue and mouth, bite the air Belly nosing: Press the other animal's body with the nose
Ludic	Play: running and jumping Animal interaction: contact between animals without damage
Normal	Drink Eat Defecate Lay/Sleep Exploitation of the environment: rummage the floors and installations Urinate

At the end of behavioral evaluation, four pigs from each pen were randomly chosen for assessing the rectal temperature, in degrees Celsius (˚C) using a digital thermometer. For the measure of environmental variables, the dry bulb temperature-DBT (˚C) and the relative humidity-RH, in percentage (%), were monitored on the two pens with data loggers (HOBO®) and the data was transferred to a computational program for analysis. For the evaluation of thermal comfort, the temperature and humidity index (THI) was used (BUFFINGTON et al., 1982), according to the following equation:

$$THI = 0.8\ DBT + \frac{RH(TBS - 14.3)}{100} + 46.3$$

in which:

THI = temperature and humidity index, dimensionless;

DBT= Dry bulb temperature, °C;

RH = air relative humidity, %.

The equipment used in this research was positioned at 1.5 m from the floor. The acoustic box was placed on top of the wall with the protection of the ceramic tile roof, the data loggers were hung on the roof and the decibelimeters and audio recorders were kept with the researchers trained for use in the 12 quadrants.

For the evaluation of the productive/zootechnical performance, the weight gain in kilograms (kg) and the consumption of rations (kg) of the pigs. With a digital scale, the 18 animals were weighted one day before the beginning and on the last day of the experiment, and the ration was weighted every two days. The food conversion was also calculated correlating the average consumption of rations and the average weight gain per animal.

The experiment was installed in the randomized block design, two treatments and fifteen replicates. The behaviors counted through the ethogram were subjected to the square root transformation ($\sqrt{x + 0.5}$) and to the analysis of variance (ANOVA); then, the averages were compared by Tukey test ($\alpha = 0.05$). The data of the other variables were subjected to ANOVA and the averages compared to the Tukey test ($\alpha = 0.05$). The analyses were done in SAS Software, version 9.3 (SAS Institute, Cary, NC, United States).

RESULTS AND DISCUSSION

In this section is presented about the results and discussion of research. This section shows in first moment, about sound and climate data. In second moment, is presented behaviors data and the discussion about the results. Below, Table No. 2 shows, for the experiment conditions, the values of the sound intensity, in dB, and the ambient temperature values (˚C) and relative humidity (%) in both pens.

Table No. 2: Average values and standard deviation of sound intensity, dry bulb temperature and relative humidity and the temperature and humidity index in the control pen and the treatment pen

Pen	Sound Intensity (dB)	DBT (˚ C)	RH (%)	THI
Control	44.28 ± 4.48 a	24.81 ± 2.31 a	68.57 ± 14.50 a	53.71
Treatment	44.27 ± 4.35 a	25.02 ± 2.32 a	68.00 ± 13.31 a	53.79

Averages followed by different letters in the same line differ from each other to the level of 5% of significance by the Tukey test.

dB: decibels; DBT: dry bulb temperature; ˚C: degrees Celsius; RH: relative air humidity; %: percentage; THI: Temperature and Humidity Index.

Although the sound frequency has been different in the pens (less than 10 khz in the control and more than 15 khz in the treatment), music played in the treatment pen was not heard by the animals in the control pen, because the dB values were statistically equal, that is, it did not interfere with the results obtained in the experiment.

According to the Code of Recommendation for the Welfare of Pigs created by the Department of the Environment, Food and Rural Affairs-DEFRA of the United Kingdom, it should be avoided to accommodate the animals in environments with constant or sudden noise intensity above 85 dB (DEFRA, 2003).

The temperature is related to the welfare and productive performance of animals and the humidity is related with the exchange of heat between the animal and the environment (DAYS et al., 2015). With limits between 16-27 ˚C, the ideal temperature for growing pigs is 21 ˚C (National Farm Animal Care Council, 2014) and humidity should not exceed 70% (SAMPAIO et al., 2004), with limits between 40-90% (FERREIRA, 2011). According to Hanh (1985), the THI with the value of up to 70 represents a safe environment for animals. During this study, it is possible observed in Table No. 2 than all these indicators maintained at a level considered adequate.

The rectal temperature of pigs weighing between 25-45 kg should be 39˚C (MUIRHEAD & ALEXANDER, 1997), similar to the animals of the control (39.34 ± 0.28) and the treatment (39.37 ± 0.31).

Tables No. 3 present the values of the agonistic, ludic and normal behaviors of the pigs for both pens, at 9 a.m. and at 4:00 p.m.

Table No. 3: Average values and standard deviation of pigs' agonistic, ludic and normal behavior of swine at 9:00 a.m. and 4 p.m.in the pen without the sensory agent (control) and with the sensory agent music (treatment)

Group of Behavior	Behavior	Pen	Time (h)	Average occurrences	Time (h)	Average occurrences
Agonistic	Fights	Control	9 a.m.	1.13 ± 1.36 a	4 p.m.	1.21 ± 1.05 a
		Treatment	9 a.m.	0.53 ± 0.74 a	4 p.m.	1.14 ± 1.41 a
Ludic	Play	Control	9 a.m.	0.07 ± 0.26 a	4 p.m.	0.79 ± 1.42 a
		Treatment	9 a.m.	0.00 ± 0.00 a	4 p.m.	0.43 ± 0.65 a
	Animal interaction	Control	9 a.m.	0.60 ± 0.83 a	4 p.m.	0.93 ± 1.38 b
		Treatment	9 a.m.	1.13 ± 1.06 a	4 p.m.	2.14 ± 1.61 a
Normal	Exploitation of the environment	Control	9 a.m.	2.67 ± 2.58 a	4 p.m.	4.71 ± 2.73 a
		Treatment	9 a.m.	3.40 ± 2.41 a	4 p.m.	5.29 ± 2.52 a
	Eat	Control	9 a.m.	4.13 ± 2.61 a	4 p.m.	3.07 ± 1.77 a
		Treatment	9 a.m.	3.00 ± 2.73 a	4 p.m.	2.50 ± 2.90 a
	Drink	Control	9 a.m.	3.47 ± 2.67 a	4 p.m.	4.00 ± 2.83 a
		Treatment	9 a.m.	1.47 ± 1.73 b	4 p.m.	4.29 ± 3.43 a
	Defecate	Control	9 a.m.	0.40 ± 0.83 a	4 p.m.	1.00 ± 0.78 a
		Treatment	9 a.m.	0.07 ± 0.26 a	4 p.m.	0.71 ± 0.99 a
	Urinate	Control	9 a.m.	0.40 ± 0.51 a	4 p.m.	1.79 ± 1.19 a
		Treatment	9 a.m.	0.20 ± 0.41 a	4 p.m.	0.64 ± 0.50 b
	Lay/Sleep	Control	9 a.m.	8.47 ± 1.81 a	4 p.m.	8.57 ± 2.87 b
		Treatment	9 a.m.	9.13 ± 1.96 a	4 p.m.	10.21 ± 2.42 a

Averages followed by different letters in the same line differ from each other to the level of 5% of significance by the Tukey test.

h: Time.

Among the stereotypical and agonistic behaviors, the fights were the only behavior observed, with the lowest value in the treatment pen for both times, but with no statistical difference. In the morning, the total amount of fights was 17 for the control pen against 8 for the treatment pen.

Piglets that heard music before weaning decreased agonistic behaviors and played more at the nursery phase, indicating positive welfare (JONGE et al., 2008). In this research, the animal interaction was greater in the pen with music, with statistical difference between the treatment and the control (2.14±1.61 and 0.93±1.38; respectively) in the afternoon, with the total amount of occurrences of 30 against 13.

As for normal behaviors, drinking was greater in the control pen than in the treatment pen (3.47±2.67 and 1.47±1.73; respectively) at 9:00 a.m. and urinate was also greater in the control pen than in the treatment pen (1.79±1.19 and 0.64±0.50; respectively) at 4:00 p.m., showing a strong relationship between both actions. Also, at 4:00 p.m., the pigs were calmer (lay/sleep behavior) in the treatment pen compared with the control (10.21±2.42 and 8.57±2.87; respectively), with the total values of the behavior of 143 versus 120. The lay/sleep behavior of this experiment reaffirms the information of Yamasaki et al. (2012) that music influences on the quality of life when it generates comfort and relaxation and reduces stress.

The productive performance of animals for both pens is showed in Table no. 4.

Table No. 4: Average and standard deviation of the productive performance of the pigs in the pen without the sensory agent (control) and with the sensory agent music (treatment)

Productive indexes	Control Pen	Treatment Pen
IW (kg)	20.61 ± 2.07 a	21.00 ± 1.98 a
FW (kg)	33.74 ± 3.16 a	33.38 ± 3.01 a
TWG (kg)	13.13 ± 1.40 a	12.38 ± 1.57 a
RC (kg)	120.89 ± 48.12 a	118.00 ± 45.11 a
FC	1.45	1.35

Averages followed by different letters in the same line differ from each other to the level of 5% of significance by the Tukey test.

IW: initial weight; FW: Final weight; TWG: Total weight gain; RC: Ration consumption; FC: Food conversion; kg:kilogram.

As noted, there were no statistical differences for the zootechnical indices, but the food conversion (quantity of ration that the animal consumes for the production of a kilogram of live weight) of the pigs in the pen with music proved to be more favorable when compared with the control pen. As seen in the table, the eating behavior in the treatment pen was lower in the two periods, with total values of 45 versus 62 at 9 a.m. and 35 versus 43 at 4:00 p.m., suggesting the improvement on food conversion of the animals in the treatment pen.

CONCLUSION

After analyzed the results of this research, is possible conclude that there is a tendency for auditory sensory enrichment (music) to have a positive influence in some behaviors in the production of pigs in the growing phase. Among the influenced behaviors are: animal interaction, lay/sleep, drink and urinate. The results of experiment for productive performance do not show statistical differences.

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