J Anim Behav Biometeorol
v.4, n.2, p.39-42 (2016)

ISSN 2318-1265

ORIGINAL ARTICLE
Artigo Original

Acoustic environment from fattening pigs building – creating and propagating of noise

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Received: March 18, 2016 ▪ Revised: March 28, 2016 ▪ Accepted: April 01, 2016

Abstract The purpose was to find effect of environmental factors (distance, feeding period, and season) on the noise emissions created from pigs housing. The measurements were made in building for 1700 fattening pigs on measuring points inside or outside of barn, always in the same time. The noise records were performed 3 times at summer and 3 times at winter season on five consecutive days and data were taken in 3 periods in relation to the feeding of pigs. Differences among periods and distances were highly significant ($P<0.001$). Inside the building, the highest noise levels ($P<0.001$) were measured. The highest average levels of noise were recorded (72 ± 1.4 dB, $P<0.001$) in the time of feeding. There were observed higher noise levels in summer than winter, both inside and outside ($P<0.01$, $P<0.001$). The results show that the noise in the pigs housing depends significantly on the period measuring, distance from building, and on the season of year.

Keywords: sound, hogs, housing, feeding period, season of the year

Introduction

The environmental problem of noise emissions is gaining increasing importance for society. Environmental noise is widespread in both natural and urban landscapes. Previous studies reviewed of Broucek (2014) have revealed many negative impacts of noise on organisms, particularly from anthropogenic sources. Most researchers agree that noise can affect an animal's physiology and behavior, and if it becomes a chronic stress, noise can be injurious to an animal's energy budget, reproductive success and long-term survival (Noren 1987; McBride et al 2003; Correa et al 2010). Husbandry procedures cause the loudest sounds, especially if metallic equipment is involved or if the work is performed in a hurried manner. The sources of noise can be technical devices, routine works (opening and closing doors, changing pens, washers, push carts, workers' speech, feed dispensing), basal sound levels caused by mechanical ventilation, animals activities (climbing and chewing on fences), and by their vocalizations (Lauer et al 2012; Mihina et al 2012).

Noise is defined as unwanted sound, either continuous or intermittent, and it can be characterized in terms including its frequency, intensity, frequency spectrum, and shape of sound pressure through time (Algers et al 1978). Decibel (dB) is unit for measuring the intensity of a sound. It is equal to ten times the logarithm to the base ten of the ratio of the intensity of the sound to be measured to the intensity level of sounds of some reference sound, usually the lowest audible note of the same frequency. Frequency means the number of vibrations per second of the air in which the sound is propagating and it is measured in Hertz (Hz) (Berglund et al 1999). Noise can be considered to be a stressor if it occurs where animals are located and if it affects their well-being and performance or induces physiological changes. Many studies on domestic animals suggest that some species appear to acclimate to some forms of sound disturbance (Algers et al 1978; Broucek 2014).

The phenomenon of noise waive propagation in the environment are very complex and a large number of parameters have to be considered in order to obtain precise and comparable results (Chevret et al 1996; Günther et al 2008). The key parameters to explore/study are related to the physical characteristics of the propagation medium on one hand (air), and to the boundary conditions (natural or artificial grounds, barriers, walls) on the other hand (Blanc-Benon et al 2001).

DOI http://dx.doi.org/10.14269/2318-1265/jabb.v4n2p39-42

The objective of the work was to evaluate effect of environmental factors (distance, feeding period, and season) on the noise emissions created from hogs housing.

Materials and Methods

The measurements were performed in building with the fully slatted floor during summer and winter seasons. The pigs at the body weight of 95 kg were kept in pens with the batch system of the management (12 sections, 12 pens in each section, and 8 animals in a pen). The negative pressure ventilation was used. The building is located about 180 m from the road. The sidewalls contained the cement-fibrous boards (thickness 30 mm) and the glass mineral wool (thickness 60 mm). The average daily air temperature and relative humidity in the housing facility were during the measuring's 24.2 ºC and 66.3 % (summer) or 15.9 ºC and 77.5 % (winter). The ventilation was turned on during measurements.

Nine places were focused by the digital rangefinder Bosch DLE 50 3 601 K16 000, where the sound intensity was consequently measured. Inside the stable the measuring point was placed in section 7, outside the building the points were placed in the distances of 7 m and 11 m.

The measurements were made three times in the summer and three times in winter on five consecutive days. In every day the data were taken in three 30 minutes periods related to the feeding – before the feeding (9:00-9:30 a.m.), during the feeding (10:00-10:30 a.m.), and after feeding (during the resting, 11:00-11:30 a.m.) of the pigs. The time of duration of all measurements being realized T = 180 s.

The sound pressure levels were measured by two digital noise meters Voltcraft Plus SL-300, EN 61672 (class of accuracy 2) in dB while using the weight filter A, and the dynamic characteristic „Fast". The microphone of sound level analyzer was placed on a tripod, approximately 1.5 m above the ground or floor level and directed towards the source of noise, i.e. the stable building (measurement from outside). By measuring inside the stable building, where is no identifiable direction of noise propagation (many of sources from all directions), the microphone was set at a random angle of incidence, i.e. vertical position.

Each measurement was realized inside and outside the building at the same time (beginning and end of measurement realized by means of two digital radio transmitters Motorola TLKR T6). Every day before the beginning of the measurements being realized, the calibration of noise meter (the so-called adjusting – adaptation of noise meter to the existing pressure) was realized by the calibrator Voltcraft 326 (IEC 60942, class of accuracy 2). The equivalent level noise pressure $L_{Aeq,T}$ was calculated. The climatic and microclimatic conditions were investigated before every series of measurements by the digital meteorological station Ws-1600 (class of accuracy 2).

The data were analyzed using a General Linear Model ANOVA of the statistical package STATISTIX 9 (Analytical Software, Tallahasee, FL, USA). There were evaluated factors of feeding period (1 = time before feeding; 2 = feeding time; 3 = time after feeding), distance of measuring (1 – 3), and season (1 = summer, 2 = winter). The normality of data distribution was evaluated by the Wilk-Shapiro/Rankin Plot procedure. All data conformed to a normal distribution. Significant differences between groups were tested by Comparisons of Mean Ranks. Values are expressed as means ± SD.

Results

Differences among distances and feeding periods were highly significant (P<0.001). Inside the building, the highest noise levels (65.5 ± 1.6 dB, 72.0±1.4 dB, 63.4±0.7 dB, P<0.001) were found. Significantly lower values were showed outside of barn, however, recorded means did not differed in comparison of distance 7 and 11 m from sidewalls. The levels of noise depend highly significantly on feeding period (before feeding, during feeding, after feeding) (Table 1). At the time of feeding (period 2), the highest levels of noise were recorded (72 ± 1.4 dB, 52.6 ± 3.0 dB, 52.4 ± 2.8 dB, P<0.001). The lowest noise levels were found after feeding (period 3) (63.4 ± 0.7 dB, 44.1 ± 1.9 dB, 44.2 ± 1.9 dB).

During summer were recorded significantly higher noise levels than during winter measuring's in all distances (67.6±3.9 dB vs. 66.3±3.8 dB, 48.7±4.3 dB vs. 46.6±4.4 dB, 48.8±4.3 dB vs. 46.3±4.2 dB) (Table 2).

Discussion

The highest noise values were recorded inside barn. Significantly lower values were showed outside, however, observed means did not differed in comparison of distance 7 and 11 m from sidewalls. The difference between 7 m and 11 m distance of measuring places from inside of barn was negligible. Major proportion of noise was absorbed by the walls of the building.

The influence of the noise produced inside barns is often neglected and mainly ventilation systems are installed regardless of the noise creating. Also feeding and manure handling can become a source of noise. Noise produced in intensive animal rearing by ventilation system (Talling et al 1998), feeding and excrement removal lines, and by animals or the staff (Venglovsky et al 2007; Mihina et al 2012). High sensitivity to noise levels has been observed in pigs with some potential impact on their behavior (Clough 1999).

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Table 1 Effects of distance and feeding period on noise (x ± SD)

Distance of measuring (m)	Feeding period			Significance
	1	2	3	
0	65.5±1.6	72.0±1.4	63.4±0.7	***
7	46.2±2.8	52.6±3.0	44.1±1.9	***
11	46.1±2.8	52.4±2.8	44.2±1.9	***

Distance of measuring: 1 = inside; 2 = outside, distance of 7 m; 3 = outside, distance of 11m;
Period: 1 = time before feeding; 2 = feeding time; 3 = time after feeding; N = 120;
SD = standard deviation; P = probability; *P<0.05; **P<0.01; ***P<0.001

Numerous studies in the field of urban sound and structural engineering have provided information on permeability of noise from anthropogenic sources (Ngai and Ng 2002; Sukontasukkul 2009). Some authors measured noise generated in the animal housing (Schäffer et al 2001; Otten et al 2004; Weeks 2008), but there is a lack of sources about noise transmittance from animal barn to outdoors, nobody has probably dealt with this problem except for us. The thickness and composition of the wall can reduce noise emissions from the barn (Bies and Hansen 2009). They found that at a noise levels were lowered by concrete panel or wood plate. Generally, the noise emissions from the barn can be reduced by the use of different noise barriers, limitation of ventilation speeds, attaching the fabric layer on the wall or alteration of texture.

The highest levels of noise were recorded during feeding. Pigs had very loud vocalization during waiting for the feed, also during eating (Algers et al 1978; Broucek 2014). Pigs often manifested aggressive behavior by pushing against each other by mangers. After feeding, when almost all pigs were already motionlessly lying, the lowest noise levels were found.

Noise values showed in all measurements inside the building of 66.9±3.9 dB is lower than that stated by Algers et al (1978) and Talling et al (1998) during housing of pigs with ventilation system. However, McBride et al (2003) recorded at the feeding of fattening pigs the noise level higher than 105 dB. The interpretation of noise assessment in animal housing is difficult as goals and methodology of differ substantially between studies. Animals not only have to accept the noise, but it also emit (Algers et al 1978; Broucek 2014).

At the present work, factor of season was found as very important for noise dissemination. Effect of season on the noise level has not been proven only in the house, but also outside. Higher noise levels in summer period recorded indoors and outdoors were caused by the need to speed air exchange, running at full ventilation is very noisy.

Table 2 Effects of distance and season on noise (x ± SD)

Distance of measuring (m)	Season		Significance
	1	2	
1	67.6±3.9	66.3±3.8	**
2	48.7±4.3	46.6±4.4	***
3	48.8±4.3	46.3±4.2	***

Season: 1 = summer; 2 = winter; Distance of measuring: 1 = inside; 2 = outside, distance of 7 m; 3 = outside, distance of 11m; N = 180; SD = standard deviation; P = probability; *P<0.05; **P<0.01; ***P<0.001

At present, the methods in simulation of propagation of the sound to the distance from hundreds of meters up to kilometers are known, and their results are not significantly different from the measured values (Chevret et al 1996; Bérengier et al 2003), but the most precise method is still the proper measurement. Properties such as thermal conductivity, thermal resistivity, heat transfer, conductance value, sound absorption at different frequency and noise reduction were investigated by Bies et al (2009). However, information on the performance of different materials on

DOI http://dx.doi.org/10.14269/2318-1265/jabb.v4n2p39-42

sound properties is limited. The problems arising from sound propagation outdoors may range from relatively simple to very complex, depending upon the nature of the source and distribution of the affected surrounding areas.

Conclusion

The environmental problem of noise emissions is gaining increasing importance for society. We can conclude that noise inside the stable building was influenced primarily by the feeding period, but we did not find high noise levels that would be harmful neither of animals nor of human. In the surroundings of the building, the dependence of noise on season of the year was ascertained. The obtained results should not be overlooked, problem is urgently important for the welfare implications.

Acknowledgement

The contribution was created from data measured in the framework of the project QH 72134 Research of principal environmental aspects in breeding of livestock from the point of view of greenhouse gases, smell, dust and noise, supporting the welfare of animals and BAT creation. The work has been supported by the "BAT centrum JU". This article was possible through projects APVV of the Slovak Research and Development Agency Bratislava (0632-10 and 15-0060), and the project CEGEZ 26220120073 supported by the Operational Programme Research and Development funded from the European Regional Development Fund.

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