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Short communication

Noise levels measuring during summer and winter in pigs' farm

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The objective of this study was to find potential impacts on the creation and propagation of sound from pig's barn. The hypothesis that the sound generated from pig housing would be influenced by the season and distance from the noise source was tested. The research was carried out in the barn for fattening pigs during summer and winter. The measurements were made indoors and outdoors the barn. At summer were recorded significantly higher noise levels outdoors (43.79±1.18 dB vs. 42.30±1.75 dB, $P<0.001$) than during winter. Significant difference between summer and winter was also calculated indoors of barn (65.03±1.60 dB vs. 63.84±1.44 dB, $P<0.01$). The measured values were in all cases higher indoors the building than outdoors. However, averages did not significantly differ in comparison of 7 m and 11 m distances from sidewalls. The results indicated that noise emitted from the pigs housing is dependent on the season of year and distance from building.

1. Introduction

Excessive noise can be considered a stressor which affects animal well-being. Some authors have reported such primary and secondary effects as reduced growth and health (McBride et al., 2003; Correa et al., 2010; Broucek 2014). However, studies on domestic animals suggest that some species appear to acclimate to some forms of sound disturbance (Algers et al., 1978; Koene et al., 2000).

Former sources have described negative implications of sound on physiological processes of animals (Otten et al., 2004; Morgan and Tromborg, 2007). But environmental noise is widespread also in urban landscapes. That sound pollution has an effect on the human population is known for a long time, but the effect of noise on farming animals has only recently been considered (Weeks, 2008).

The noise level is associated with the propagation of sound in the atmosphere, including velocity of propagation, attenuation within the medium, refraction by wind and temperature gradients, the effect of fog and precipitation, scattering and fluctuations due to turbulence, and ground reflection effects and the influence of vegetation. Outdoor sound propagation is influenced by many other mechanisms, including terrain type, and obstructions (buildings, barriers, vegetation) (Bass et al., 1995; Attenborough, 2007). The most important parameters are the atmospheric absorption (temperature and humidity), and the refraction of sound waves by the wind (wind speed, direction, and stability). It must be considered the atmospheric turbulence, the diffraction of sound around obstacles, and relative humidity (Mahdi and Al-Jumaily, 2012). The propagation of sound is the highest when the relative humidity is between 20 % and 30 %.

On the basis of the frequent questions from animal protection authorities we found that there are no data from husbandry with large numbers of animals, for finishing pigs with the highest body weights. Therefore, we determined the hypothesis of our research that noise forming from housing building with a large number of pigs would be influenced by the season of the year and measuring distance.

2. Materials and methods

The measurements were performed in building during summer and winter seasons. Barn for 1750 pigs (the average body weight 95 kg) was consisted from 12 sections, 12 pens were in each section. The size of pen was 30 m x 22.5 m. The batch system of the management was used. The liquid feeding with distribution of the feed 4 times a day was applied. 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). Outside of the barn was only grassland.

The measurements were performed 3 times in the summer (June, July, August) and 3 times in the winter (December, January, February) on 5 consecutive days. The data were recorded twice during the morning, when the animals had no feed (9 a.m. to 9.30 a.m., 11 a.m. to 11.30 a.m.). At the recordings was ventilation system turned on. We designed 9 points for repeated measurements (one inside the barn, spacing 0 m, and eight outside the building in the distances of 7 or 11 meters from barn walls). 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. The indoors and outdoors measurements were made at the same time. Every day before the beginning of the measurements being realized, the calibration of noise meter was realized by the calibrator Woltcraft 326 (IEC 60942, class of accuracy 2). The equivalent level noise pressure LAeq,T was calculated.

The average daily air temperature, relative humidity, atmospheric pressure, and air velocity in the housing facility were during three five-day periods in summer (24.2 ºC, 66.3 %) and winter (15.9 ºC, 80.8 %) season. The average daily air temperature, relative humidity, atmospheric pressure, and wind speed outdoors the housing building were represented during three five-day periods in summer (26.2 ºC, 63.8 %) and winter (5.0 ºC, 73.3 %).

The data were analyzed using a General Linear Model ANOVA of the statistical package STATISTIX 9 (Analytical Software, Tallahasee, FL, USA). The factors were consisting season (summer, winter) and distance of measuring (0 m, 7 m, and 11 m). 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.

3. Results and discussion

At the present work, the factor of season had significant effect on the sound propagation. During summer observations were recorded outdoors significantly higher noise levels (43.79±1.18 dB vs. 42.30±1.75 dB, $P<0.001$)

than during winter, similarly in both distances 7 and 11 m. Significant difference between summer and winter was also calculated indoors of barn (65.03±1.60 dB vs. 63.84±1.44 dB, P<0.01). These higher noise levels in summer period recorded indoors and outdoors were caused by the need to speed air exchange, more opened windows and doors. But, their role could also play outside temperatures, humidity, or atmospheric pressure. A proportion of sound energy is converted to heat as it travels through the air. There are heat conduction, shear viscosity and molecular relaxation losses (Bass et al., 1995). Humidity is also an important factor in the diurnal variation. Usually the diurnal variations are greatest in the summer (Attenborough, 2007). Indeed differences between summer and winter observation were namely more distinct in these parameters of temperature and humidity, difference between wind speeds was negligible (0.55 m.s-1 vs 0.65 m.s-1).

Mahdi and Al-Jumaily (2012), which the effects of relative humidity and atmospheric temperature on noise investigated, showed that the strong dependence of atmospheric attenuation of sound waves on relative humidity and temperature occur when relative humidity is less than 30 %. There is linear relationship between the speed of sound and the combination of relative humidity and atmospheric temperature. Wet air absorbs sound better than dry air. With regard to sound propagation, the component of the wind vector in the direction between source and receiver is most important (Attenborough, 2007).

The measured values were in all cases higher inside the building than outside (65.47±1.62 dB, 9.00 a.m. - 9.30 a.m.; 63.38±0.69 dB, 11.00 a.m. - 11.30 a.m.). Lower noise levels were recorded outdoor of barn; however, averages did not significantly differed in comparison of 7 m and 11 m distances from sidewalls (43.68±1.62 dB, 42.45±1.46 dB vs. 43.59±1.60 dB, 42.45±1.41 dB). This means that the 4 m length between outdoor locations is inconsiderable. Most sound pollution was obviously absorbed by the sidewalls of the building. Some authors measured noise generated in the animal housing (Otten et al., 2004; Venglovsky et al., 2007; Weeks, 2008), but there is a lack of sources about sound transmittance from pigs barn to outdoors.

The thickness and composition of the sidewall can reduce noise emissions (Bass et al., 1995). Usually the harmful load can be reduced by the use of different noise barriers, or adjusting panels (Mahdi and Al-Jumaily, 2012). However, information on the sound penetration of material that we used (cement-fibrous boards and glass mineral wool) is limited.

All our measured sound levels were lower than the EU limits or than values showed by Venglovsky et al. (2007), Talling et al. (1998), and McBride et al. (2003) during housing of pigs with ventilation system. It is clear that pigs also generate its own noise by vocalization, but feed dispensing and removal of dung can become a source of noise (Mihina et al., 2012).

Our work highlights the importance of potential impacts on the noise environment. In the surroundings of the building, the dependence of noise on season of the year was ascertained. Noise levels inside the stable building were influenced primarily by the period of the day, but we did not find high noise levels that would be harmful neither of animals nor of human.

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