CARBON DIOXIDE CONCENTRATION IN FARROWING PENS FOR LACTATING SOWS AND PIGLETS

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ABSTRACT

Carbon dioxide (CO_2) is one of the most important gases causing global warming. The aim of the paper was a comparison of the CO_2 concentration in the different places in pig barn (lactating sow zone, piglets zone). Research was done in the Experimental Centre for Livestock of Department of Animal Husbandry in FAaFR, SUA in Nitra, Slovakia, with Large White sows with piglets. There were individual farrowing pens with permanent limited range of motion for sows in the barn. Air samples were measured in each pen in sow zone as well as piglets zone. For the experiment was used the INNOVA photoacoustic field gas system. Average values of CO_2 concentration ranged from 515.293 to 519.580 ppm. Data shown no statistically significant differences between CO_2 concentration in the lactating sows zones and piglets zones at the 95.0 % confidence level. Air circulation between the zones in the pig barn was on the sufficient level.

Key words: carbon dioxide, lactating sow, piglets, farrowing pens

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INTRODUCTION

Agriculture contributes significantly to total greenhouse gases (GHGes) emissions (Monteny et al., 2006; Dubeňová et al., 2011a; Dubeňová et al., 2011b). Approximately from 20 to 35 % of the global greenhouse gas (GHG) emissions originate from agriculture (IPCC, 2001). Livestock is the source of many pollutants such as gases, odors, dust and microorganisms. In the livestock buildings were found 136 gases (Karandušovská et al., 2011). Ventilation systems reduce and control dust concentration in pig houses (Topisirovic and Radivojevic, 2005; Topisirovic, 2007).Agriculture in general, and livestock production in particular, contribute to global warming through emissions of the greenhouse gases: nitrous oxide (N_2O) and carbon dioxide (CO_2). Air pollution is the third largest threat to our planet after biodiversity loss and climate change (most affected by CO_2).Global atmospheric concentration of these the most important greenhouse gases increased significantly within the last 150 years (IPCC, 2001) and it affects the atmospheric environment – increased greenhouse gases emissions(Zavattaro et al., 2012). Carbon dioxide emissions differ from one rearing system to another, e.g. weaning and fattening pigs (Dubeňová et al., 2011a; Philippe et al., 2007; Philippe et al., 2011). Gases, especially CO_2, production by animals is essential parameter for ventilation rate estimation using a mass balance method (Pedersen and Ravn, 2008). Methods of manure removal affect the production of harmful gases in the evaluated barns for fattening pigs (Mihina et al., 2011). The process of releasing GHG into the atmosphere depends on methods of livestock husbandry, nutrition conditions, manipulation with slurry and manure and its storage and land application (Palkovičová et al., 2009), number and weight of animals, type and time intervals of manure removal, temperature in barn, moisture, pH reaction of litter, C:N ratio, etc. Type and efficiency of the ventilation system significantly affects gas concentration in the pig building (Topisirovic et al., 2010a, Topisirovic et al., 2010b). The gaseous emissions from livestock houses are thus dependent on the housing and on the floor systems (Cabaraux et al., 2009).The aim of our research was a comparison of the CO_2 concentration in the different places in pig barn in the zones of lactating sows and piglets and unveil the contrast among animal groups.

MATERIAL AND METHODS

Measurements were done in the Experimental Centre for Livestock of Department of Animal Husbandry of Faculty of Agrobiology and Food Resources of the Slovak University of Agriculture in Nitra, Slovakia. Pigs were housed in farrowing pens with permanent limited range of motion of lactating sows. Sows of Large White breed with their piglets were used in the experiment. Basic characteristics of pigs are shown in table 1.

Tab. 1 Basic characteristic of lactating sows and piglets

Sample point	Weight of sow, kg	Age of piglets, days	Range of piglets weight, kg	Average value of piglet weight, kg	Order of farrowing	Number of piglets, pcs.
1	303	8	1.26 – 2.69	1.99	5	14
2	333	15	2.35 – 7.50	6.03	4	6
3	304	14	3.97 – 5.06	4.62	3	9

Samples of air were collected in each pen both in sows zone and piglets zone. Sampling points in piglets zones were placed in the corner of each pen in 0.25 m height above floor. Sampling points in sow zones were placed in the middle of the pen also in 0.25 m height above floor. Sampling places were monitored for 48 hours. In the whole pig barn was used natural ventilation. Devices of INNOVA (LumaSenseTechnolgies, Inc., Denmark) were used for measurement of the gases concentration (www.bruel.ska,b).Measuring system consist of three main parts:Photoacoustic field gas-monitor INNOVA 1412, multipoint sampler INNOVA 1309 and computer with software.

Data were analysed by using Kruskal-Wallis Test after normality test by using Kolmogorov-Smirnov test and homogeneity of variance by using Levene's test. Used software was SAS ® 9.2 (SAS Institute, Inc.; Cary; North Carolina, USA). Graphic processing of results was performed using software STATISTICA 7 (Statsoft, Inc.; Tulsa, Oklahoma, USA). The Kruskal-Wallis test tests the null hypothesis that the medians within each of the six samples are the same. Since the P-Value is greater than or equal to 0.05, there is not a statistically significant difference amongst the medians at the 95.0 % confidence level.

RESULT AND DISCUSSION

There were monitoring three farrowing pens with permanent limited range of motion in the same barn. Samples of air were collected in each pen both in **L**actating**S**ow **Z**one (**LSZ**, number) and **P**iglets **Z**one (**PZ**, number).

Tab. 2 Summary statistics of CO_2 concentration for all sampling places

Sampling place	Sample Size	Average, ppm	Standard deviation	Minimum, ppm	Maximum, ppm	Range, ppm
LSZ1	248	515.293	75.6973	329.270	662.563	333.293
LSZ2	248	517.817	74.1871	338.775	659.284	320.509
LSZ3	248	518.303	75.9395	331.052	659.448	328.396
PZ1	248	515.397	75.2527	337.468	642.123	304.654
PZ2	248	517.553	74.5180	322.925	667.537	344.611
PZ3	248	519.580	75.4791	334.014	663.164	329.150

Average of CO_2 concentration ranged from 515.293 to 519.580 ppm (Table 2 and Figure 1). The P-Value in the Kruskal-Wallis test is greater than 0.05 (P-Value = 0.989537). There is not a statistically significant difference among the medians of CO_2 concentration in the three farrowing pens in the zones of lactating sows and piglets at the 95.0 % confidence level.Lowest and highest ranges of values were measured in the piglets zones. It could be cause by the activity of piglets, because it was in the pens where piglets had a different age and weight (Table 1).

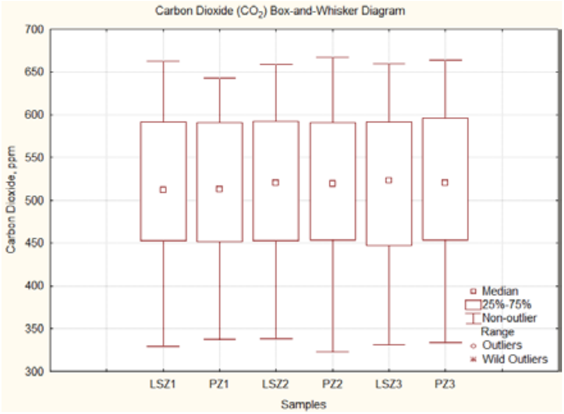

Fig. 1 Box-and-Whisker plot of CO_2 concentration for all sampling places

CONCLUSIONS

The aim of our evaluation was a comparison of the carbon dioxide concentrations in the zones of lactating sows and piglets in the farrowing pens and unveil the contrast among animal groups. Pigs were housed in farrowing pens with permanent limited range of motion and natural ventilation system. Sows of Large White breed with their piglets were used in the experiment. Three farrowing pens in the same barn were monitored. Air samples were collected in each pen both in lactating sows zone and piglets zone. Average values of greenhouse gases ranged from 515.293 to 519.580 ppm for carbon dioxide. There was used Kruskal-Wallis test. The P-Values in the Kruskal-Wallis test for carbon dioxide was and 0.989537. P-Value was greater than 0.05. There is not a statistically significant difference among the medians of CO_2 concentration in the three farrowing pens with permanent limited range of motion in the zones of lactating sows and piglets at the 95.0 % confidence level. Lowest and highest ranges between the values of CO_2 gas were measured in the piglets zones. It could be caused by the activity of piglets which is affected by their different age and weight. Based on our results, air circulation between the zones of lactating sows and piglets in the pig barn was on the sufficient level.

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