# AMMONIA CONCENTRATIONS IN BROILER HOUSING

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***Abstract**: The aim of the project was to find out if there are any differences in $NH_3$ concentrations during winter´s and summer´s breeding of broilers. This information would then also contribute to the question of whether there are significant differences in $NH_3$ emissions. Ammonia concentration levels were collected continuously during whole growing period in summer and winter season. There exist seasonal variations in $NH_3$ concentrations. Specifically, daily mean $NH_3$ concentrations in the house ranged from 0,95 to 13,17 ppm in summer, whereas the daily mean $NH_3$ concentrations in winter were 2,83 to 23,19 ppm. Ammonia concentrations were lower in summer than in winter. The higher $NH_3$ levels in winter were attributed to the lower ventilation rate during cold weather.*

***Keywords**: ammonia concentrations, broiler housing*

## Introduction

Housing is the major emission source for intensively reared livestock, such as pigs, poultry, and cattle. More than 90 % of ammonia leakage comes from animal breeding. Ammonia emissions are not constant over the year, but can change seasonally. The degree of seasonal variation depends on the geographic region, animal sector, and type of animal production practices used. Ammonia is released from manure and urine, especially during storage and decomposition. It slowly rises from the manure and spreads through the building and is removed by the ventilation system. It is colourless gas, lighter than air, highly water-soluble, and has a pungent odour with detection threshold between 5 a 18 ppm (Jacobson, 2003). According to the general technical requirements on construction, the animal housing have to be designed made so as to ensure a healthy environment and not endanger housing and animal husbandry. The monitoring and reduction of emissions of greenhouse gases it must also be ensured (Pogran, Lendelová, 2011). Increasing demands on the quality of animal products making it necessary to deal with the improving of the animal housing conditions, which include mainly microclimate conditions of the environment such as temperature and humidity (Balková, Pogran, 2009).

## Methods

For measuring of ammonia concentration was used the device 1312 Photo-acoustic Multi-gas Monitor of firm INNOVA Air Tech Instruments with multi-channel sampling system 1309. This equipment was installed in a redeveloped broiler house kept on deep litter. Ammonia concentrations and ventilation rates were continuously recorded during whole growing period in the four ventilation shafts - two points at the input of the ventilation shafts and two points in front of tunnel fans at the back end of the house. The outdoor concentrations of ammonia was measured as well. Ammonia in the air was transported from the ventilation shafts through heated and insulated tubes to the analyser. Approximately 25,000 birds were placed in the houses immediately after hatching and grown until the market age of 49 days. After each growth cycle, the house was vacant for approximately two weeks between flocks. There has been insulated ceiling and full insulating sidewalls. Ventilation system has included six fans (9 000 $m^3h^{-1}$) in the roof and four tunnel fans (35 000 $m^3h^{-1}$). Box inlets have been located along both sidewalls and have been automatically controlled via cable based on maintenance of set point static pressure difference. Besides the measuring of concentrations there was carried out continuously measuring of indoor temperature.

## Results and discussion

The hourly mean $NH_3$ concentrations inside the house were in the range of 0,95 to 4,45 (table 1) ppm during the first week of growing period in the summer season, whereas the daily mean $NH_3$ concentrations during the first week of growing period in winter season were 1,05 to 2,93 ppm (table 2). The weekly mean concentrations in summer at three different sample spots in the house fan 1; fan 2; fan 3 were 2,147; 2,614; 1,905 ppm respectively and in the winter season were 1,863; 1,982; 1,928 ppm. In spite of the fact that average indoor temperature was lower (26,7 °C) in summer than in winter (31,6 °C) $NH_3$ concentrations were higher in summer than winter. It was speculated that the faster and greater quantities of air movement over the manure surface would increase ammonia release. Interestingly $NH_3$ concentrations house were generally higher in the last week of growing period in summer and winter than in the first week. Figure 1 shows the measured ammonia concentrations in the last week of growing period in summer. Figure 2 shows the measured ammonia concentrations in the last week of growing period in winter. The hourly mean $NH_3$ concentrations were in the range of 1,30 to 13,17 ppm during the last week of growing period in the summer season (table 1), whereas the daily mean $NH_3$ concentrations during the last week of growing period in the winter season were 2,83 to 23,19 ppm (table 2). The higher $NH_3$ levels in winter were attributed to the lower ventilation rate during cold weather.

***Table 1.***

***Measuring values of ammonia concentrations in summer - first week and last week of growing***

| Parameter | **Summer season - at the first Week of growing period** | | | | **Summer season - at the last Week of growing period** | | | |
|---|---|---|---|---|---|---|---|---|
| | F1 | F2 | F3 | Temp. | F1 | F2 | F3 | Temp. |
| Range of ammonia concentrations vppm | 0,95-4,04 | 1,15-4,45 | 0,98-3,22 | 22,8-30,2 | 1,43-9,278 | 2,77-13,17 | 1,30-9,00 | 19,5-30,7 |
| Average v ppm | 2,15 | 2,61 | 1,91 | 26,7 | 3,77 | 6,87 | 5,33 | 24,1 |
| Standard deviation | 0,76 | 0,86 | 0,68 | 1,6 | 1,66 | 2,87 | 1,92 | 3,7 |

***Table 2.***

***Measuring values of ammonia concentrations in winter - first week and last week of growing***

| Parameter | **Winter season - at the first Week of growing period** | | | | **Winter season - at the last Week of growing period** | | | |
|---|---|---|---|---|---|---|---|---|
| | F1 | F2 | F3 | Temp. | F1 | F2 | F3 | Temp. |
| Range of ammonia concentrations v ppm (2) | 1,13-2,62 | 1,24-2,93 | 1,05-2,71 | 27,3-35,8 | 2,83-14,58 | 4,32-23,19 | 3,59-15,63 | 20,6-27,8 |
| Average Ppm (3) | 1,86 | 1,98 | 1,93 | 31,6 | 6,26 | 9,70 | 7,91 | 23,6 |
| Standard deviation (4) | 0,35 | 0,39 | 0,36 | 2,8 | 2,30 | 4,78 | 3,70 | 1,9 |

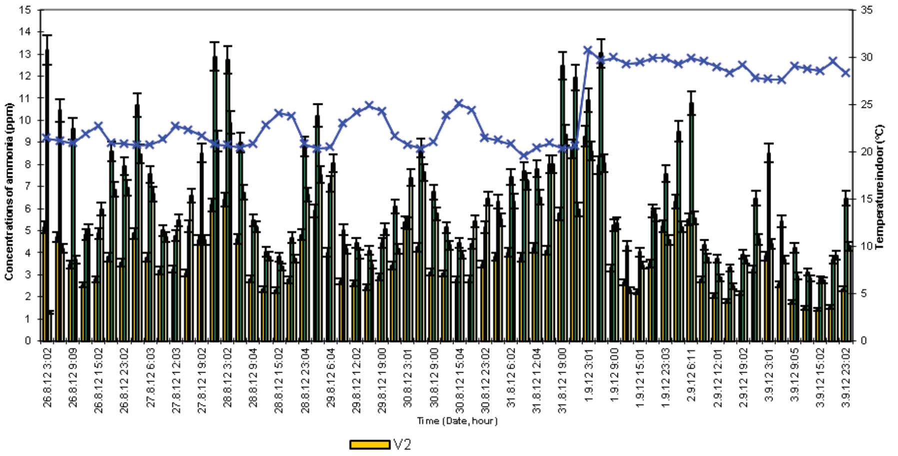


***Figure 1. Weekly profiles of ammonia concentrations in the last week of growing period in summer***

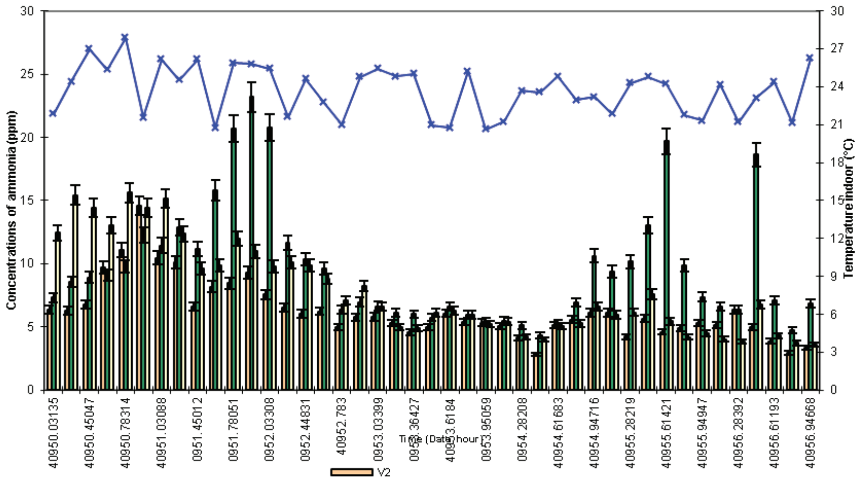


***Figure 2. Weekly profiles of ammonia concentrations in the last week of growing period in winter***

## Conclusion

There exist both weekly and seasonal variations in ammonia concentrations. Mean ammonia concentrations varied from 0,95 to 4,45 ppm in the first week in summer and from 1,047 to 2,93 ppm in winter. However, the highest mean concentrations were occurred in the last week when the floor with litter was increasingly covered with chicken droppings and ranged from 1,30 to 13,17 ppm in summer and 2,83 to 23,19 ppm in winter. The ammonia concentrations were below the general threshold limit of 25 ppm for an 8 h working day for men and the living environment of animals.

Slovakia has signed all important environmental conventions. The most significant change in political life of the country was the accession to the EU in May 2004. This step also implies an intensive transposition of a large framework of environmentally oriented legislation in all sectors. Council Directive 96/61/EC on Integrated Pollution Prevention and Control was transposed into Slovak legal framework by adopting the Act No. 245/2003 Coll. on Integrated Pollution Prevention and Control coming into force on the 31st of July 2003.

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**Докладът е рецензиран.**