Relationship of ammonia and total bacterial air load with airway inflammation, lung consolidation and lower airway infection in indoor group housed calves

K. van Leenen¹, L. Van Driessche¹, J. Jouret³, P. Demeyer⁴, L. De Cremer¹, L. Gille¹, C. Masmeijer¹, F. Boyen², P. Deprez¹, B. Pardon¹

¹ Department of Large Animal Internal Medicine, Faculty of Veterinary Medicine, Ghent University - Merelbeke (Belgium),
² Department of Pathology, Bacteriology and Avian Diseases, Faculty of Veterinary Medicine, Ghent University - Merelbeke (Belgium),
³ Belgian Centre for occupational hygiene - Zwijnaarde (Belgium),
⁴ Unit Technology and Food, Flemisch Research Institute for Agriculture and Fisheries - Merelbeke (Belgium)

Introduction
In calf housings air ammonia concentrations < 4.7 – 6 ppm are recommended. Recently, total bacterial air load is increasingly being used as an additional air quality parameter. The objective of this study was to quantify ammonia concentrations and total bacterial air load in indoor calf group housings and to determine associations with airway inflammation, lung consolidation and lower airway infection.

Methods
Clinical examination, thoracic ultrasound and non-endoscopic broncho-alveolar lavage were performed on 202 indoor group housed calves, aged 1 to 6 months from 33 conveniently selected Belgian herds. Broncho-alveolar lavage fluid (BALf) was analyzed for total nucleated and differential cell count and bacterial culture performed. Air ammonia concentrations were measured for a 24-hour period using a multi-gas monitor and bacterial air load was determined by sampling 1 liter stable air onto a blood agar plate with an impaction-type air sampler.

Results
Mean ammonia concentrations were 1.8 ppm (standard deviation (SD) 1.2; range (R) 0 – 10). On 33.3% (11/33) of the farms sampled ammonia concentrations exceeded the cut-off of ≤5 ppm at least at one point in time. Mean total bacterial air load was 3.1 x 10⁵ cfu/m³ (SD 1.2 x 10⁵, R 2.8 x 10⁴ – 4.0 x 10⁵). No association was found between ammonia concentration and total bacterial air load in stable air. Of the calves 42.6% (68/202) demonstrated a lung consolidation with a depth of ≥ 1 cm on ultrasound. Pasteurella multocida was isolated in 25.7% (52/202) of the calves, Mannheimia haemolytica in 19.3% (39/202), Histophilus somni in 7.9% (16/202) and Mycoplasma bovis in 3.0% (6/202) of the calves. Mean BALf total nucleated cell count (TNCC) was 1.8 x 10⁹ cells/L (SD 1.4; R 0.0 - 8.2) and mean neutrophil percentage was 36.1% (SD 24.6; R 0.5 – 97.3). A significant positive association was found for isolation of P. multocida and BALf neutrophil percentage. No associations were found for ammonia concentrations and total bacterial air load with lung consolidation, lower airway infection and lower airway inflammation.

Conclusion
Neither air ammonia concentrations nor bacterial air load were associated with lung consolidation, lower airway inflammation and infection suggesting that the influence of other air pollutants should be explored.