A simple method to determine the ammonia levels in order to improve the cage conditions for the mice

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Introduction

Cages housing mice fed with high fat diet (HFD) smell more intensively compared to cages housing mice fed with standard diet (SD).

High ammonia level causes irritation and pathological changes in the nasal mucosa of mice.

In this study, we wanted to compare the ammonia levels between the cages housing these two groups of mice.

Materials and Methods

- Two groups of mice were fed either HFD or SD.
- The mice were housed under standard conditions, 5 males per cage in IVCs (Allentown NexGen, 535 cm² floor area).
- A Small Animal Ammonia Sensor (VetTech solutions Ltd, UK) was placed inside the cage close to the lid, on top of the waterbag.
- The sensor indicated four different ammonia levels:
  - 0-1
  - 1-25,
  - 25-50
  - >50 ppm
- Ammonia levels were recorded daily during 21 days.
- The cage change interval was 1 week.

Results

- The ammonia sensor was easy to use and read.
- Results were obtained for 3 weeks from one device
- Measurements were obtained continuously.
- During this study ammonia levels increased rapidly reaching >50 ppm within 5-6 d after cage change for mice fed HFD while mice fed SD, the levels of ammonia remained below 25 ppm until day 7 after cage change

<table>
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<th>Days</th>
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<tr>
<td>7</td>
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</tbody>
</table>

Ammonia levels (ppm) and no.s of observations in mouse cages on 1-7 days after cage change.

1High Fat Diet, 2Standard Diet

Conclusions

- The sensor provided a valuable tool to measure ammonia levels continuously within individual IVCs.
- Interpretation of results are user dependent.
- The sensor helps to:
  - identify research models where mice risk high ammonia exposure.
  - adapt cage change frequency to animal needs.
A simple method to determine the ammonia levels in order to improve the cage conditions for the mice

The aim of the present study was to monitor the ammonia levels in individually ventilated cages (IVC) used for housing mice fed either standard diet (SD) or High Fat Diet (HFD).

Materials and methods:
Two groups of male mice (n=5) C57bl/6J were housed in Allentown (NexGen) IVC system with floor area of 535 cm². The nominal air change rate was 50 cycles per h and the relative humidity was 50±5%. The room temperature was kept at 22 ± 2° C and the light/dark cycle was kept at 12 hrs.
Each cage was equipped with aspen wood chips (approximately 112 g), a plastic house, nesting material and chewing sticks. The cage beddings were changed once weekly.

The two groups both the SD and the HFD were fed ad lib with two types of diet (ENVIGO- Global Diet- T.2918 (SD) or Research Diets - D12492i (HFD)). Body weights (g, mean±SD) for the SD and HFD mice were 31±2 and 54±6, respectively. The age of the mice was 18 and 30 weeks for SD and HFD, respectively. The mean food consumption was 2.6 and 2.3 g/mouse/d and the water consumption was 2.6 and 2.4 g/mouse/d for the SD and HFD groups, respectively.
The mice included in the study were assigned for metabolic investigation that was approved by the local ethical committee.

Ammonia levels were measured by use of a Small Animal Ammonia Sensor (VetTech solutions ltd, UK) placed inside the cages. The sensor was placed on top of the water bag, separated from the animals. The ammonia levels were measured by comparing a color indicator to a reference value. The sensor indicated four different levels (0-1, 1-25, 25-50 and >50 ppm).
Each group of the mice was monitored daily for three weeks and the ammonia levels were registered in the morning by the same technician except for weekends.

Results showed that the ammonia levels increased rapidly reaching >50 ppm within 5-6 d after cage change for mice fed HFD while mice fed SD, the levels of ammonia remained below 25 ppm until day 7 after cage change.

Discussion
The exposure of ammonia at high levels has been reported to cause irritation and pathological changes in the nasal mucosa of mice. Our results give insight and guidance to re-evaluate the cage change frequency and procedures for specific research models e.g. diabetes and/or HFD based models.

In conclusion, the Small Animal Ammonia Sensor is a user friendly device that provides a valuable tool for continuous monitoring of the ammonia levels in the IVC system. The sensor helps to identify research models at high ammonia exposure risk. The sensor may be a valuable tool to be utilized as indicator for cage change procedures and hence minimize the risk for high ammonia exposure.