

METHOD FOR ASSESSING GAS CONCENTRATIONS IN BROILER FARMS

Legal requirement: “[...] gas concentrations must be kept within limits which are not harmful to the animals.” (Directive 98/58 EC, Annex, Paragraph 10)

Legal requirement: “[...] (a) the concentration of ammonia (NH₃) does not exceed 20 ppm and the concentration of carbon dioxide (CO₂) does not exceed 3000 ppm measured at the level of the chickens’ heads.” (Directive 2007/43 EC, Annex II, Paragraph 3)

Description of the method

The method recommended involves measurements of resource-based animal welfare indicators, namely concentrations of ammonia (NH₃) and carbon dioxide (CO₂). For the measurements to be valid and reliable, the method requires a measuring device (i.e. a gas meter) that can measure NH₃ and CO₂. Notice that some gas meters are configured for a single gas (e.g. GasBadge Pro¹), whereas others can measure multiple gasses (e.g. Ventis Pro²).

Preparation for each inspection

- Make sure that the gas meter has been calibrated within the last six months in a certified laboratory. Under farm conditions, the accuracy of the gas meter may degrade due to interference with other gases³. The regular comparison with a standard gas mixture or reference device allows the detection of possible drift of devices used routinely.
- Make sure that the gas meter measures 0 ppm NH₃ outdoor in open air.

During the inspection

- Number of points measured in the barn:
 - ≥600 m²: six measures in total, with two measures per one-third of the barn.
 - <600 m²: four measures in total, with two measures in each half of the barn.
- For each measure, the gas meter is held still at the height of the birds’ heads for one minute, after which the gas concentration is noted.
- When choosing the specific measuring point:
 - Take the airflow from the ventilation into account.
 - Make sure that some measures are near feed and water lines.
 - Avoid the wettest areas.
- When measuring CO₂ concentration:

¹ E.g.: <https://www.indsci.com/en/products/gas-detectors/gasbadge-pro/gasbadge-pro-monitor/>

² E.g.: <https://www.indsci.com/en/products/gas-detectors/ventis-pro/ventis-pro-series-monitor/>

³ Hassouna Mélynda, Eglin Thomas et al., 2015. Mesurer les émissions gazeuses en élevage : gaz à effet de serre, ammoniac et oxydes d’azote. Diffusion INRA-ADEME. 314p. ISBN : 2-7380-1375-9.

- Make sure not to exhale in the direction of the gas meter.
- Do not measure directly under the heating sources.

After inspection

- Disinfect the gas meter.
- Let the gas meter run in open air outdoor until it shows 0 ppm NH₃ before being used during a new on-farm inspection. This is done to remove any NH₃ accumulated in the sensor during the completed inspection.

Interpreting the data

Only the competent authorities in the Member States are allowed to interpret the legislation and to decide how to use the measurements of gas concentrations to verify compliance with the legislation, i.e. the concentration of NH₃ does not exceed 20 ppm, and the concentration of CO₂ does not exceed 3000 ppm.

From interviews of official veterinarian inspectors from different Member States, it appears that there are two main ways of using the measurements:

- 1) Calculate the average of the six measures and use the mean to decide whether the gas concentration complies with the legislation.
- 2) Use the highest measure to decide whether the gas concentration complies with the legislation.

Uncertainties/reservations

- Gas concentrations fluctuate within a day, between days and between seasons. The method described above is a point observation valid only for the time of measuring.
- The gas meter is costly and needs regularly calibration for a sufficiently high level of reliability.
- There are differences between models and brands of gas meters in accuracy, so before purchasing gas meters this should be examined. The accuracy has been shown to be between 1% and 15% when the measurement is carried out on a reference gas (a mixture of CO₂ or NH₃ in pure air)⁴. To compensate for possible inaccuracy of measurements due to differences between gas meters, some Member States accept an increase in the threshold. For example, the competent authorities in France accept a 30-% increase in

⁴ Précision de la mesure des concentrations en gaz. The French Poultry Technical Institute (ITAVI) and Institut National de la Recherche Agronomique (INRA).

gas concentrations, resulting in thresholds of 26 ppm for NH₃ and 3900 ppm for CO₂⁵.

Sources

A number of sources have been searched for protocols on how to measure gas concentration in poultry barns. These include scientific peer-reviewed articles and documents collected from competent authorities in Member States within EU and from non-EU countries within Europe. The methods considered to have the highest validity and reliability, while still being feasible during on-farm inspections, were found in protocols from the French⁵ and Swiss⁶ competent authorities. The present method has been developed based on these protocols.

For now, this is the best method available for measuring gas concentrations during animal welfare inspections that EURCAW-Poultry-SFA can offer. However, there is room for improvements, and methods that are more accurate may be developed and delivered in the future.

⁵ Protocol 'DGAL/SDSPA/2017-998', Direction générale de l'alimentation, Service des actions sanitaires en production primaire, Sous-direction de la santé et de protection animales, Bureau de la protection animale (BPA), France.

⁶ Protocol 'Luftqualität', Division of Animal Welfare, Federal Food Safety and Veterinary Office FSVO, Switzerland.