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# Environmentally-acceptable feeding pig production III

## Influences at different times of the day

*Selected $NH_3$ and $C0_2$ emissions over the day along with the different influential factors from a fully slatted, forced ventilation pig production building and a naturally ventilated building with separate climate areas were compared. The aim was to test which variables were mainly responsible for the differing daily emission results and to what extent concepts for influencing emission rates through barn climate recording and control could be applied in emission reduction measures.*

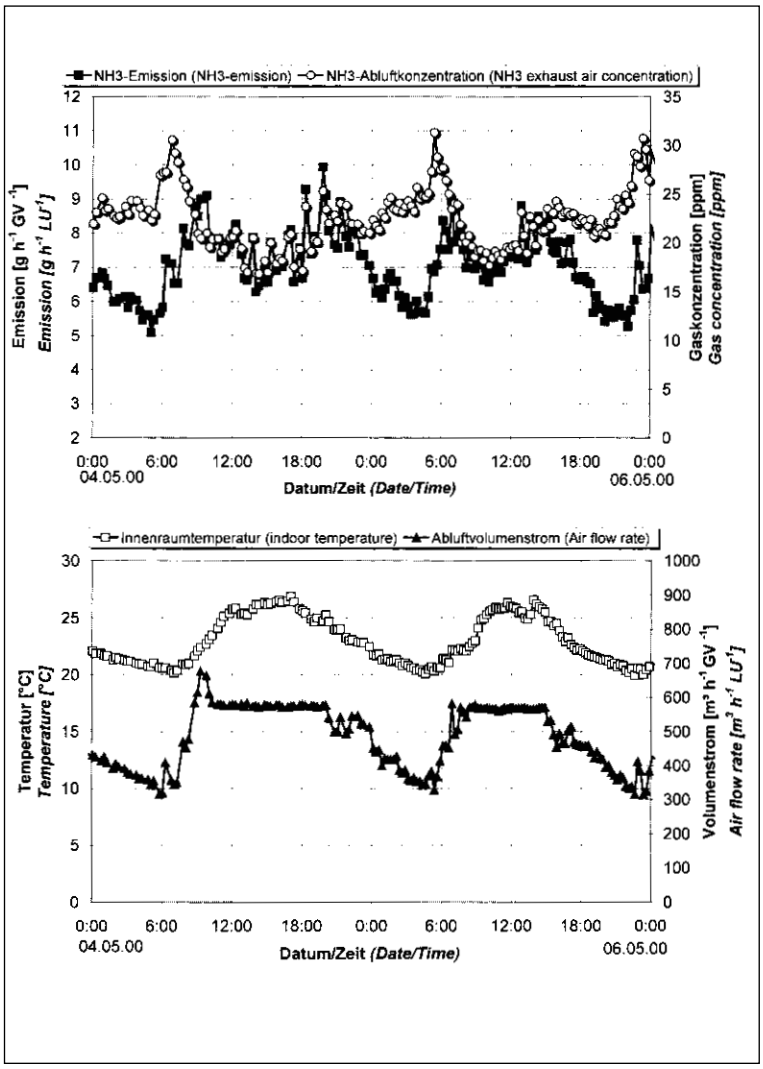


*Fig. 1: Interior temperature, volume flow, $NH_3$ exhaust concentration recordings over two days in May (66th to 68th feeding day) in a fully slatted forced ventilation system*

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## Keywords

Pig husbandry, pollution control, ammonia and greenhouse gas emissions

## Literature

Literature details are available under LT 02404 via Internet at http://www.landwirtschaftsverlag.com/landtech/local/fliteratur.htm

Within the framework of continuous emission measurements in a Hohenheim trial building for feeding pigs conventional fully slatted accommodation with forced ventilation was compared with a naturally ventilated system with separated climate areas over four feeding cycles from October 1999 to April 2001 [1, 2]. The description and analysis of effects at various times is the focal point of this third report in the series on environmentally-acceptable feeding pig production.

### Method

The analysis of daily recordings was based on three selected representative recording periods within the second feeding cycle (March to June 2000), each of from four to five days. In order to investigate the complexity of the relationships and the strength of the influences on the emissions, separate variables were established for each production system which was then used for a multiple linear regression analysis (separate for every measurement period). In the main these comprised exterior and interior temperatures, air volume flow and gas concentrations as well as the differences between day and night. In a second analysis of reduced regression models, variables were tested which could be applied in practice in barn climate recording and control and, where required, could be used to influence emission reduction measures (day/night, exterior and interior temperatures, temperature difference, air volume flow, interior $CO_2$ concentration). Further information on the choice of variables and the statistical methods used are included in the full-length version of this re-

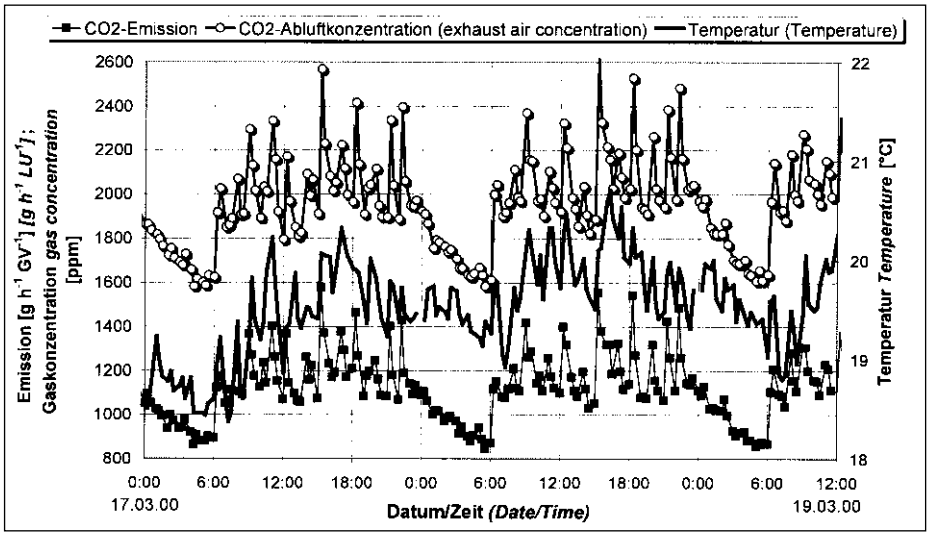


*Fig. 2: Interior temperature, $CO_2$ exhaust gas concentration and emission rate recorded over three days in March (feeding days 18 to 20) in a fully slatted forced ventilation system.*

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### Results

The evaluation of representative recordings of $NH_3$ and $C0_2$ emissions and the different influencing factors with the fully slatted, forced ventilation system showed that:

- The $NH_3$-emissions in the case of fluctuating volume flows could in the main be explained through the factors volume flow (positively correlated) and exhaust air concentration (negatively correlated)
- the day/night dynamic of the $NH_3$ emissions could be determined mainly through the dynamic of the temperature progress and resulting volume flows as well as being able to be traced back to short-term peaks in livestock activity caused by the feeding procedure (*fig. 1*).
- the day/night dynamic of the $CO_2$ emissions, on the other hand, could be explained mainly by the livestock activity caused by the feeding procedure (sensor-controlled liquid feeding between 6.00 and 22.00 hours at intervals of around 1.5 hours) which increased $CO_2$ exhaust air concentration and temperature (both positively correlated) (*fig. 2*).

The most important observations for the free ventilation system compared with the slatted and forced ventilation one are:

- The extent and fluctuations of the volume flow are much greater; and the temperatures, gas concentrations and emissions, as a rule, are much smaller.
- Contrary to the slatted system, the volume flow is negative with the $NH_3$ emission correlated, i.e. rising volume flows cause a reduction in emission (*fig. 3*)
- Contrary to a temperature controlled forced ventilation system the volume flow in natural ventilation is greatly influenced by the wind conditions as well as continuing to be positively correlated with temperature difference and negatively correlated with interior temperature.

It is assumed that the $NH_3$ delivery potential of the naturally ventilated house is less and also slower because of the lower temperatures and that the structuring of the housing system resulted in no consistent flowing over of emitting surfaces despite higher volume flows. It also has to be recognised that during cool temperatures the pigs remain mainly within the covered lying areas and that the contribution to gas concentrations in these areas to emissions is not clear.

The proportion of the explainable variance in recorded emissions assessed through large animal unit based emission rates for the selected recording periods influenced by variables which can be practically applied in barn climate recording and control and, where appropriate, have an influence in the context of emission reduction actions represented between 12% and 75% for NH3 in the slatted system and, for CO2, from 39% to 47%. In the natural ventilation system the proportion of the explainable variance is less with 52% to 64% (NH3) and 18% to 28% (CO2). Up until now only the variables day/night and interior CO2 concentration have been used in the models as direct indicators for livestock activity. The aim was to test whether the results, through using a periodically highly-developed activity signal could be improved. An improvement in the model for the natural ventilation system is possibly attainable via further parameters which take more account, above all, of the factors determining volume flow and temperature difference and their interaction.

For a detailed representation of the daily recordings and discussion of the results the full-length version of this report in LANDTECHNIK-NET is recommended.

*Fig.3: Interior temperature, volume flow, $NH_3$ exhaust concentration and emission rate on two days in May (feeding days 66 to 68) in system with separate climate areas with natural ventilation.*