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Experimental analysis of airborne dust and moulds in horse barns

The etiology of chronic obstructive pulmonary disease (COPD) in horses is closely connected with the amount of dust particles and mould spores in the air of horse barns. The chronic disease pattern is based on a permanent mechanical irritation and a hypersensitivity reaction of the respiratory tract resulting from long-term exposure to high aerosol concentrations.

For the present dissertation, airborne dusts and moulds in two different horse barns of the Röttgen stud farm in Cologne/Germany were studied in detail. Apart from a quantitative analysis of the aerosols, the main focus of the research was not only on qualitative analyses such as the identification of mould types and the measurement of particle size distributions, but also on the detection of potential dust and mould sources in the barns. Moreover, the acquired data were checked for possible correlations between dust particles and mould spores.

In addition to the concentration development of dust particles, it was also possible to carry out long-term measurements of the concentration of mould spores in the air. This was made possible by using an eight-stage Andersen sampler and by a modification of the dust analysis carried out after sampling. Thus, it was possible to avoid the problem of individual stages being overloaded, which often occurs with six-stage Anderson samplers when germ concentrations are high and sampling takes place over longer periods of time. Moreover, the Anderson sampler was successfully used to analyse the size structure of moulds. By this method it was possible to obtain satisfactory and reproducible results.

Due to the different day-to-day activities in horse barns, the concentration of dust particles is subject to great fluctuation. To accomplish a constant dust level, selective measurements were carried out at specific times of day. These investigations were complemented with tests using a dust releasing box developed at the Institute of Agricultural Engineering, which was used to simulate dust levels occurring during the feeding of horses with roughage. Both experimental setups were designed to produce homogenous concentrations of airborne dust and mould.

The long-term measurements showed that the concentration of airborne particles in horse barns is subject to great diurnal fluctuation, which results in wide scattering of the obtained data. The biggest influences on the development of peak concentrations are the processes of mucking out and refilling the horse boxes with fresh straw as well as the

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handling of roughage. The analysis of the particle size distribution showed a predominance of fine particles in the barn air, especially of particles with a size of 0,3-0,4 μm . In addition to the human influence on dust development in the stable during working phases, dust concentrations are kept at a certain level by the constant resuspension of particles due to animal activity.

The mould concentrations measured in the barns ranged from 3.9 to 5.9×10^5 CFU/m³ air. The most common mould genera were *Eurotium*, *Wallemia* and *Cladosporium*. The latter two, which were found in batches of straw and hay, are very likely sources of mould in the barn air. By using an Andersen sampler it was possible to establish that spores are in a size range between 2.1 and 4.7 μm , which enables them to penetrate to the deep regions of the lungs.

A statistical analysis of the relationship between dust particles and mould spores showed a high coefficient of determination only for similar aerosol concentrations and under standardized conditions. The data from the horse barns showed only weak correlations between these two parameters. It was not possible to make predictions about mould levels on the basis of long-term measurements of dust particles in the field studies. This would require additional measurements of airborne germs as well as an indirect detection method.

On the basis of these investigations it was possible to isolate weak points in barn management and hygiene and to develop corrective measures to be taken in horse keeping.