WOOD SHAVINGS AND BIOCOMPOST AS BEDDING MATERIAL IN HORSE STABLES TO ENSURE AIR QUALITY DEMANDS – THE AGONY OF CHOICE?

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SUMMARY

Objective: The susceptibility and reaction of stabled horses to inhaled airborne pollutants is often associated with bedding materials, which have a poor hygienic status. In a field study we evaluated a new biocompost bedding material for horse stables with respect to its impact on air hygiene and compared the results to those from a reference trial with wood shavings.

Methods: The study was conducted in a naturally ventilated stable. Ammonia and thermophilic actinomycetes as air hygiene parameters were measured 24 hours a day for seven days with each bedding type.

Results: During the monitoring period wood shavings were associated with mean ammonia concentrations of 12.6 ppm, while biocompost caused only 5.1 ppm. On the other hand, the concentrations of airborne thermophilic actinomycetes were highest with biocompost (14,822 vs. 84 colony forming units per m³).

Conclusions: This investigation clearly shows that potential advantages and disadvantages of new bedding materials have to be weighed very carefully. To ensure the well being of horses, any new bedding material must be tested very carefully before it is introduced to the market.

Keywords: horse, biocompost, wood shavings, bedding material, air hygiene

INTRODUCTION

Recurrent airway obstruction (RAO; chronic obstructive pulmonary disease, COPD; heaves) in horses is linked closely to aerial environmental factors including noxious gases and bioaerosols, which may be highly concentrated in the air inhaled by animals kept indoors (Clarke 1987). The susceptibility and reaction of stabled horses to inhaled bioaerosols is often associated with mouldy bedding material and foodstuff containing fungal spores and actinomycetes. In the aetiology of chronic respiratory diseases the quality of raw bedding materials and type of management can be of great relevance, because differences in the ability of these materials to release particulates can be often observed. While straw is a major source of released particles, wood shavings emit only negligible or moderate amounts of particles. Alternative bedding materials for horses such as biocompost are being sought in order to optimise indoor environmental conditions. Biocompost is made of plant wastes, disintegrated, and fermented by aerobic microbes and supplemented with peat because of its water binding capacity.

The present study evaluated such a biocompost bedding material for horse stables with respect to its impact on air hygiene and compared the results to those from a reference trial with wood shavings. The whole study is comprehensively documented and published by Seedorf et al. (2007).

MATERIAL AND METHODS

The study was conducted in a naturally ventilated stable with four pens occupied by one horse each. The basic microclimate between pens was characterised by online electronic measurement of the temperature and relative humidity of the air within the pens. The concentrations (ppm) of the aerial gases ammonia (NH_3) was determined continuously by photoacoustic infrared spectroscopy.

A set of IOM (Institute of Occupational Medicine, Edinburgh, UK) samplers was equipped with polycarbonate filters (pore size 0.8 µm) to sample airborne thermophilic actinomycetes in the pens. Exposed filters were shaken gently with sterile isotonic NaCl solution to dissolve the collected microorganisms. Afterwards the basic suspension was diluted and an aliquot of the dilutions was inoculated on glycerol arginine agar. The aerobic incubation temperature was 50°C for thermophilic actinomycetes. In accordance with their specific growth potencies, growing colonies were counted after 14 days of incubation. The findings are expressed as colony forming units (CFU) per m^3 air. Measurements were also made outdoors. Reference measurements of temperature, relative humidity and total bacteria were made to record environmental influences on indoor conditions during the trials. I

Data were recorded 24 h a day during all 7 sampling days within the 2-week trial with each bedding material tested. Each measurement sequence started at 06.00 h and stopped automatically at 06.00 h the following day. The next sequence was initiated 24 h later and so on. The continuously measured data on temperature, relative humidity and gas concentrations were averaged per day and box. The calculated mean values were then expressed in relation to a maximum available sample size of n = 28 (4 boxes x 7 days). Due to the cumulated sampling procedure over 24 h, the theoretical sampling size for airborne thermophilic actinomycetes was also 28. Since there may be natural fluctuations in the numbers of colony forming units during the cultivation of microorganisms, 3 replicates were carried out per box and day, to give an ideal sampling size of 84. As the Shapiro-Wilks test showed that the data sets were not distributed normally, medians, and minimum and maximum values are presented. The Mann-Whitney U test was used for statistical comparison of the corresponding data for the same tested factor on the basis of the sampling sizes for each trial.

RESULTS

There was an indoor median temperature difference of 2.9°C between the test phases with wood shavings (21.5°C) and biocompost (18.6°C). In contrast to the significant temperature difference, the relative humidity was similar with wood shavings (66.8%) and biocompost (69.6%). During the 7-day monitoring periods the average ammonia concentrations scarcely exceeded 5 ppm in the stable with biocompost, while it was nearly 13 ppm with wood shavings. According to these data the difference was significant ($p<0.001$). Minimum and maximum values ranged from 1.6 ppm to 9.1 ppm (biocompost) and from 1.8 ppm to 22.9 ppm (wood shavings).

The median concentration of thermophilic actinomycetes was 14,822 CFU/m³ with biocompost and 84 CFU/m³ with wood shavings ($p<0.001$). A peak concentration of 113,426 CFU/m³ during the biocompost trial corresponded to a maximum value of 503 CFU/m³ during the wood shavings test phase.

The median outdoor values were 15.8°C and 73.0% during the wood shavings trial and 12.0°C and 77.0% during the biocompost trial. The relative magnitude of bacterial accumulation in the stable was assessed by outdoor measurements conducted once a day over the entire trial period. Concentrations were similar in both surveys, with 750 CFU/m³ outdoors during the wood shavings trial and 875 CFU/m³ during the biocompost trial ($P>0.05$).

DISCUSSION AND CONCLUSIONS

Animal welfare considerations have led to recommendations that ammonia concentrations in stables should not exceed 10 ppm (Anon 1995). In this study, NH_3 was nearly 13 ppm with wood shavings and with biocompost only 5.1 ppm, maximum <10 ppm. Biocompost can efficiently absorb urine and the relatively high water content enhances the shift from volatile ammonia to water-bound ammonium. Because the biocompost was supplemented with small amounts of peat, both its water (urine) holding and ammonia binding properties were improved (Airaksinen et al. 2001).

Certain important health-related properties of biocompost can be attributed to its production conditions. For example, thermal energy is generated when organic plant waste rots. The increase in temperature due to aerobic fermentation may have a sanitising effect, but favour the growth of thermophilic microorganisms. Therefore, an accumulation of bacterial types such as thermophilic actinomycetes can be expected. From this point of view the potential of biocompost to release actinomycetes is a serious problem, because these microbes may induce sensitisation of the airways, ultimately leading to COPD (Mair and Derksen 2000).

In conclusion, the biocompost bedding material tested in this study seems to be an alternative to other common materials; among its positive hygienic and animal welfare properties these are low concentrations of airborne ammonia, for example. However, its enrichment with substantial amounts of thermophilic actinomycetes, represents a potential health threat, because human and animal activities in the stable cause the release and accumulation of inhalable actinomycetes and complementary agents (e.g. moulds) into the stable air, potentially initiating and maintaining respiratory disorders in susceptible individuals due to combined effects. In consideration of these aspects, biocompost tested here cannot be recommended as bedding material for horses in stables. Furthermore, this report also stresses the necessity of testing any new bedding material product before it is introduced to the market and weighing very carefully its advantages and disadvantages to ensure the well-being of horses.

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