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Microbiological Air Emissions from a Cattle Barn

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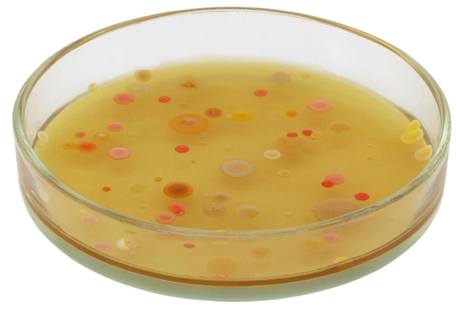

INTRODUCTION

Intensification of animal production is correlated with the concentration of a large number of animals in a small area. This situation poses significant risks to both human health and the environment. The primary role of animal hygiene, apart from creating optimal conditions for livestock, is to prevent the negative impact of animal husbandry on the natural environment. Animal farming is a considerable source of biogenic elements. The bacterial flora of outdoor air differs qualitatively and quantitatively from the bacterial flora found in livestock buildings. Livestock buildings can be considered incubators that facilitate the proliferation of microorganisms and parasites. This environment is promoted by factors such as higher internal air temperatures compared to external air during the winter period, elevated levels of airborne dust, and increased moisture content. The restricted living space of the animals also plays a crucial role. These conditions collectively contribute to the spread of infectious and invasive diseases within livestock facilities. Microbiological contamination of air is defined by the presence of viruses, bacteria, and fungi in the air. Intensive livestock farming may pose threats to the natural environment and cause discomfort to local residents and tourists. The aim of this study was to assess the level of microbiological contamination in the environment of a dairy cattle farm.

Keywords*: cattle barn, environment, microbes*

OBJECTIVES AND METHODOLOGY

The study was conducted on a dairy farm located in a tourist area within the ecologically pristine Beskidy Mountains region. Investigations took place during the winter and spring seasons. During the study period, the cowshed housed 240 animal units of Red-and-White Lowland cattle. The research included an assessment of microclimatic conditions inside the cowshed and its surroundings, as well as a microbiological analysis of air samples.

Air samples were collected using an MAS 100-Merck air sampler inside the cowshed and along a designated transect to determine the distance at which airborne microorganisms dissipated. Sampling points were located inside the building and at 5 m, 25 m, and 75 m from the cowshed on the downwind side, and approximately 25 m from the building on the upwind side, serving as a control point. Samples were obtained by aspiration through forced airflow, depositing microorganisms directly onto microbiological culture media. After incubation, the number of colonies grown was converted into colony forming units (CFU)—which denotes both spores and mycelium fragments for fungi, and both vegetative cells and spores for bacteria—per cubic meter of air, according to the formula provided by the air sampler manufacturer.

Microclimatic parameters were measured during each sampling event at five fixed points inside the cowshed and at one point 25 m outside the building. The recorded parameters included temperature, relative humidity, cooling power, air movement rate, and concentrations of ammonia, carbon dioxide, and ozone.

RESULTS

Tab.1 Amount of microorganisms in air [CFU/m^3]

Olace of measurement	Seasone of measurement	Bacteria total	Staphyloco-ccus sp.	Enterobacter	E. coli	Fungi
Inside of buildibg	Winter	1200	668	52	1	670
	Spring	9216	8330	250	17	6980
5 metres from the cowshed	Winter	62	22	0	0	58
	Spring	283	180	0	0	283
25 metres from the cowshed	Winter	44	2	1	0	36
	Spring	100	0	0	0	240
75 metres from the cowshed	Winter	18	0	0	0	47
	Spring	111	6	0	0	208
Control point	Winter	17	0	0	0	3
	Spring	115	4	0	0	192

Salmonella, Shigella, and Proteus bacteria were not detected.

Tab. 2. Mean value of microclimatic factors

Place of measurement	Season of measurement	tmperature [°C]	cooling power [mW/cm^2]	air flow [m/s]	humidity [%]	Ozon [µg/m^3]	NH_3 [ppm]	CO_2 [%]
Cowshed	winter	10.22	45.35	0.27	67.3	45.1	trace	1115
	spring	20.34	44.97	0.49	77.3	41.5	trace	515
Outside	winter	5.2	103.9	1.96	60.0	51.0	-	300
	spring	14.5	50.29	0.94	74.3	51.8	-	300

CONCLUSIONS

•The comparative analysis of microclimatic parameters and microbiological data demonstrated a significant relationship between the concentration of airborne microorganisms and environmental conditions. Higher temperature and relative humidity were associated with increased levels of microbial contamination in the air.

•The degree of microbiological air contamination in the vicinity of the cowhouse was dependent on the distance from the building. A clear decrease in the number of airborne microorganisms was observed with increasing distance, indicating that the cowhouse constituted the primary source of bioaerosol emissions.

•The level of microbiological contamination within the impact zone of the cowhouse reached values comparable to those recorded at the control site only at a distance of approximately 75 m from the building. This finding suggests that the influence of the cowhouse on the microbiological quality of ambient air extends up to at least 75 m from the source.