

OCCUPATIONAL EXPOSURE TO BIOCONTAMINANTS, HEALTH COMPLAINS AND RESPIRATORY DISORDERS AMONG CAFO'S WORKERS

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Background and objective

Animal production is characterized by organic dust exposures with high biological activity. It contains the microbial components that can contribute to the pulmonary impairment. Some studies showed decline in lung function among farm workers exposed to these factors. This study was focus on exposure assessment to bioaerosols (bacteria and molds, organic dust, endotoxin) and irritant gases as well as analysis of cross-shift changes in lung function among polish animal farmers.

Methods

Occupational exposure assessment was carried out in 30 swine farms. The spirometry before and after the shift were done among 90 swine workers using portable spirometer (Spirolab II) and 94 office workers as a control. Health questionnaire survey were done among swine workers. Organic dust was collected using personal aerosol samplers. Endotoxin was assayed with the LAL test in a kinetic, chromogenic version. Ammonia was measured using Draeger pipes. Cross-shift changes in FVC, FEV1, FEV1/FVC and FEF25-75 were analyzed. Relationships between pulmonary function changes and environmental parameters were calculated. Mixed effects regression models were used to estimate the concentration of environmental agents. Linear regression were used to identify predictors of pulmonary changes.

Results

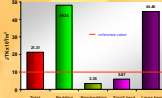
Swine farm workers were exposed to wide range of concentrations of organic dust (0.2-37.2 mg/m³), culturable bacteria (4.4-106x10⁴) and molds (0.02-10.8x10⁴), endotoxin (95.0-147885 EU/m³) and ammonia (2.5-30.1 ppm). The worst conditions were found in the building without the mechanical ventilation, use of deep bedding and where the head of pigs exceeded 500 animals.

Exposure to biohazards and ammonia among swine workers (N=90)

Biohazards	GM	SD	Min - Max
Organic dust [ng/m ³]	5.38	5.41	0.16 - 37.2
Endotoxin [EU/m ³]	9481	23281	95.0 - 147885
Airborne bacteria x 10 ⁴ [CFU]	47.8	33.1	4.35 - 106
Airborne fungi x 10 ⁴ [CFU]	1.55	3.63	0.02 - 10.8
Ammonia [ppm]	8.33	1.83	2.5 - 30.1

* based on samples from 14 confinement buildings

Total bacteria concentration according to swine barns characteristic



Total fungi concentration according to swine barns characteristic



Analysis of spirometric parameters has revealed significant declines in FEV1 after the work shift. Exposure concentrations associated with decline in pulmonary function among 3% and 5% of workers were respectively 2.05 and 2.64 mg/m³ for respirable dust, 72.7 and 1266 EU/m³ for respirable endotoxin and 4.0 and 6.7 ppm for ammonia.

Cross-shift declines in selected spirometric parameters values among exposed and controls

Spirometry	Exposed n = 90	Controls n = 94	p values
FEV1	14.44	6.38	0.1202
FVC	7.78	4.26	0.4867
FEV1/FVC	17.78	2.13	0.0089
FEF25-75	35.56	21.28	0.0479

Biohazard borderline values when significant cross-shift decline in FEV1 has been observed (among 3% or 5% of workers)

Agents of exposure [units]	Borderline values	
	3%	5%
Dust respirable fraction [ng/m ³]	> 5	> 5
Endotoxin respirable fraction [EU/m ³]	72.7	1266
Ammonia [ppm]	32.3	> 50

* decline in FEV1 was observed in at least 3% or 5% of workers exposed to specified agent

Risk of selected symptoms related to dust and endotoxin concentration

Symptoms	Factor (concentration) *	IS	p
Allergic total	Dust inhalable (>2)	2.63	0.100
	Endotoxins (>5000)	1.70	0.436
Respiratory tract (upper/lower)	Dust inhalable (>2)	2.62	0.091
	Endotoxins (>5000)	1.60	0.454
„Eye“	Dust inhalable (>2)	1.30	0.683
	Endotoxins (>5000)	2.63	0.090
„Like flu“	Dust inhalable (>2)	0.82	0.735
	Endotoxins (>5000)	0.64	0.470

* Dust inhalable – [µg/m³]; Endotoxins – [EU/m³]



Discussion

Bioaerosol present in CAFO's worker environment may induce allergic symptoms and cross-shift declines in lung function parameters. Dose-response trends between increasing dust, ammonia and endotoxin concentration and cross-shift declines in workers lung function were found.

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