



MOULDS AND BACTERIA IN THE AIR OF WASTE SORTING PLANTS AS AN OCCUPATIONAL FACTOR RESULTED SPECIFIC HEALTH SYMPTOMS AND ALLERGIC DISEASES AMONG WORKERS



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THE SPECIFICITY OF EXPOSURE IN WASTE SORTING PLANTS

- ❖ Municipal waste contains about 50% organic fraction.
- ❖ Direct contact of workers with waste.
- ❖ Organic dust is a carrier of bacteria, protozoa, fungi, viruses, and synthesized and secreted by them to the environment:
 - * inflammatory substances (endotoxin, (1-3)-β-D-glucans),
 - * toxic substances (mycotoxins),
 - * allergic substances (proteins).



THE AIM OF THE STUDY

The aim of the study was to assess the relative risk of selected health complaints and occurrence of allergic diseases in sorting plants workers.



MATERIAL AND METHODS

MEASUREMENT STRATEGY

- 2 waste sorting plants were under study
- Survey was conducted in summer season
- Measurements in the indoor air was carried out based on Polish Standard (PN-EN 13098: 2002 Workplace atmospheres - Guidelines for measurement of airborne microorganisms and endotoxin)

AIR SAMPLING - MOULDS

- **method A:** air sampler Mass-100 (Merck)
air volume: 10 and 20 l; air flow: 100 l/min
medium: Malt Extract Agar (MEA) with chloramphenicol
incubation: 30°C, 5 days
- **method B:** one-stage Andersen air sampler
air volume: 2 l, 7,5 l, 15 l; air flow: 30 l/min
medium: Malt Extract Agar (MEA) with chloramphenicol and streptomycine
incubation: 30°C, 5 days

Total number of samples N=37

AIR SAMPLING - MESOPHILIC BACTERIA

- **method A:** air sampler Mass-100 (Merck)
air volume: 10 and 20 l; air flow: 100 l/min
medium: Columbia Agar+5% Sheep Blood (bio-Merieux)
incubation: 37°C, 2 days
- **method B:** one-stage Andersen air sampler
air volume: 5L, 10 l, 20 l; air flow: 30 l/min
medium: Nutrient agar with nystatine
incubation: 30°C, 2 days + 37°C, 1 day

Total number of samples N=21

SAMPLING POINTS

- Broadcasting station
- Sorting cabins
- Press
- Reloading station
- Office
- Background (*atmospheric air*)



HEALTH QUESTIONNAIRE SURVEY

Questionnaire included 30 questions covering, among others:

- potentially allergic symptoms (respiratory, eye and skin)
- allergic diseases diagnosed by a doctor
- smoking habit

CHARACTERISTICS OF THE STUDY POPULATION

Exposed group

included all workers of sorting plants which have direct contact with the waste and were present in the day of survey

N = 69

Control group

included office workers not exposed in the workplace to biological agents

N = 205

COMPARISON OF AGE IN THE EXPOSED AND CONTROL GROUP:

Group:	Age [year]			The level of significance of differences p
	Arithmetic mean AM	Median Me	Standard deviation SD	
exposed	42,8	44	10,3	0,957
control	42,1	44	10,7	

ESTIMATORS OF EXPOSURE

- Mean concentration of moulds in the indoor air (in CFU/m³)
- Mean concentration of mesophilic bacteria in the indoor air (in CFU/m³)

ESTIMATOR OF RELATIVE RISK

- Odds ratio (OR) was used as an indicator of the relative risk
Odds ratio calculations were based on the comparison of exposed and control group

RESULTS

CHARACTERISTICS OF WASTE SORTING PLANTS

Waste sorting plant	Efficiency		The average height of waste storage [m]	Storage time [in days]	Number of sorting cabins N
	yearly [in thousands of tonnes]	daily [in tonnes]			
I (relatively new, bigger)	82,5	330	3	1	3
II (old, smaller)	50,0	170	3	1	1

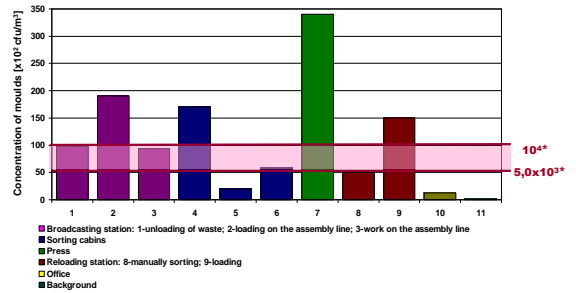
CONCENTRATIONS OF TOTAL MOULDS INCLUDING THE PROCESSING CAPACITY OF THE PLANT AND MICROCLIMATE

Sorting plant	No. of samples (method)	Temp. [°C]	Humidity [%]	Total moulds [cfu/m ³] x 10 ³					
				Working hall			Office room		Back-ground
				N	AM	AM	Min-Max	SD	
I	10 (A)	29,4	52,0	5,5 – 160,0	49,1	48,3*	5,9	1,2	
	11 (B)	21,3	56,8	1,9 – 34,0	9,8	13,0	1,3	0,1	
II	11 (A)	26,5	51,7	15,0 – 140,0	46,6	78,0*	2,0	1,4	
	5 (B)	17,8	59,4	24,5 – 44,5	8,2	33,8	—	1,1	
Total	37	25,0	55,9	1,9 – 160,0	73,5	44,7	3,2	1,0	

AM – arithmetic mean; SD – standard deviation; Background – atmospheric air; — lack of data; * p<0,05

Reference exposure range values for moulds 5,0 x 10³ – 1,0 x 10⁴ (Malmros P., Sigsgaard T., Bach B. Occupational health problems due to garbage sorting. Waste Management Res. 1992, 10, 227-234.)

Concentration of moulds determined at following technological stages in I waste sorting plant



* Reference exposure range values for moulds (Malmros P., Sigsgaard T., Bach B. Occupational health problems due to garbage sorting. Waste Management Res. 1992, 10, 227-234.)

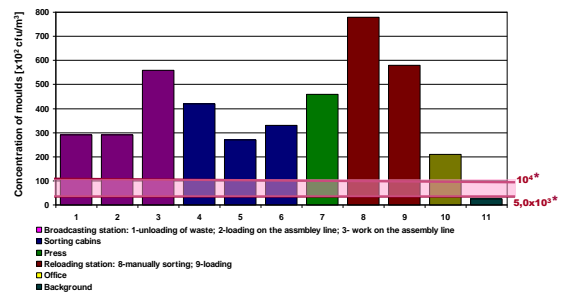
CONCENTRATIONS OF MESOPHILIC BACTERIA INCLUDING THE PROCESSING CAPACITY OF THE PLANT AND MICROCLIMATE

Sorting plant	No. of samples (method)	Temp. [°C]	Humidity [%]	Total bacteria [cfu/m ³] x 10 ³					
				Working hall			Office room		Back-ground
				N	AM	AM	Min-Max	SD	
I	2 (A)	29,6	53,4	19,0 – 25,0	4,2	22,0*	-	-	
	11 (B)	19,0	64,0	18,0 – 58,0	13,7	37,6*	21,0	2,5	
II	3 (A)	26,6	52,6	36,0 – 59,0	13,0	44,0*	—	—	
	5 (B)	21,0	71,6	44,6 – 58,0	12,3	57,9*	—	2,8	
Total	21	24,7	57,4	18,0 – 71,5	15,9	41,4	21,0	2,6	

AM – arithmetic mean; SD – standard deviation; Background – atmospheric air; — lack of data; * p<0,05

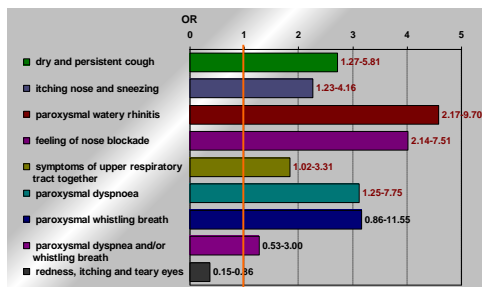
Reference exposure range values for moulds 5,0 x 10³ – 1,0 x 10⁴ (Malmros P., Sigsgaard T., Bach B. Occupational health problems due to garbage sorting. Waste Management Res. 1992, 10, 227-234.)

Concentration of bacteria determined at following technological stages in I waste sorting plant



* Reference exposure range values for moulds (Malmros P., Sigsgaard T., Bach B. Occupational health problems due to garbage sorting. Waste Management Res. 1992, 10, 227-234.)

Relative risk (OR, CI*) of selected allergic symptoms



* OR - odds ratio; CI - confidence interval

CONCLUSIONS

- Concentrations of moulds and bacteria determined in waste sorting plant environment exceed the recommended exposure range.
- A value of moulds and bacteria concentrations depend on the phase of the technological process.

CONCLUSIONS

- ❑ Relative risk of selected allergic symptoms were increased in case of paroxysmal watery rhinitis, feeling of nose blockade, paroxysmal dyspnoea, dry and persistent cough and itching nose and sneezing.
- ❑ To protect health of workers it is needed to intensify preventive activities aimed at minimizing bioaerosol concentrations at the workplace and making the protection of eyes, skin and respiratory system much more effective.