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EFFECT OF A MUNICIPAL WASTE STOCKPILE ON THE OCCURRENCE OF SELECTED BACTERIA IN ATMOSPHERIC AIR

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Introduction

Waste disposal at dumping sites brings about potential hazard for human health, as it may pollute air, water and soil. Apart from their basic role, which is environmental protection, these facilities introduce remarkable amounts of pollutants of gaseous, and microbiological character. Municipal waste is the habitat of various microorganisms emitted into atmospheric air, where they exist in the form of bio-aerosols. The kind of microorganisms emitted into air, the range of their occurrence, and their number depend on many factors, such as: the type and location of a facility, the weather conditions, and a time of the year. Bio-aerosols emitted by dumping sites may consist of: viruses, bacteria, spores of fungi, protozoan cysts and parasites ova. On this account municipal landfill sites can be a potential source of many diseases of bacterial and other origin (Krzysztofik 1986, Barabasz et al., 2001).

The aim of the study was to assess the degree of the atmospheric air microbiological pollution with the bacteria *Escherichia coli* and S*treptococcus* spp. in a municipal landfill site in one of the towns of the kujawsko-pomorskie district. The hazard was assessed on the ground of registered levels of bacterial aerosol concentration in appointed research points. The influence of the time of the year on the bacteria tested number was also tested.

Material and methods

Three measurement points, situated in selected Municipal Waste Utilization Plant, were chosen to carry out the monitoring of the atmospheric air:

Stand 1 – activated waste dumping site

Stand 2 – embankment scarps of ground dumping site lining (top)

Stand 3 – compost maturing shed (air samples were taken during compost piles sieving).

The research dealing with the occurrence of bacteria in the air were conducted from April till November 2003 (in the first decade of each month). Air samples for microbiological analyses were taken with the aspiration method according to Polish Standards PN-89 Z – 04111/02 and PN-89 Z-04111/03 using the special apparatus – Microbiological Air Sampler

MAS – 100 Eco™. The following media were used for the isolation of microorganisms tested:

- ENDO agar with fuxine and lactose for *E. coli* and other bacteria of genus *Enterobacteriaceae*
- Agar with kanamicine, esculin and azide for bacteria of genus *Streptococcus*
- The number of bacteria in 1 m^3 of air was calculated on the ground of the conversion table and the jtk number obtained

Results and discussion

Microbiological research of the atmospheric air at the municipal waste disposal site showed the quantitative variety of the bacteria tested at particular stands and in different times of the year.

The results of the count of bacteria of the genus *Enterobacteriaceae*, particularly *Escherichia coli*, are presented in Table 1. The highest degree of air contamination by E*scherichia coli* was observed at the place of compost piles turning (stand 3). Most were detected in July (650 jtk/m^3 of air), however the high level maintained in April and May as well. At the stand 1 and 2 the highest air contamination by *E. coli* occurred in June, while from August till November they were detected in a very small number or not detected at all. The most count of other bacteria of the genus *Enterobacteriaceae* was noticed in July (12600 jtk/m^3 of air) and the least – in November.

The highest number of bacteria of the genus *Streptococcus* (18920 jtk/m^3 of air) was noted at the activated waste dumping site (Table 2). Both at the stand 1 and the embankment scarp of dumping site lining (post 2) the most of the bacteria were isolated in June. The occurrence of fecal streptococci was remarkably the highest at the place of pile turning. The maximum of 69 jtk were detected at this stand in April, while in July and November there were only 3 jtk in 1m^3 of air.

Table 1. The number of *Escherichia coli* and other bacteria of the *Enterobacteriaceae* from April to November at the stands tested

		Terms-month (cfu/m^3)							
		April	May	June	July	August	September	October	November
Stand I	E. coli	4	10	245.5	50	0	0	10	0
	other	28	26	6550	2440	58	40	276	10
Stand II	E. coli	2	4.5	87	0	0	0	5	2
	other	6	41	1393	10	26	5	53	0
Stand III	E. coli	235	292	50	650	0	21	151	3
	other	48	342	15	12600	40	200	104	19

Table 2. The number of bacteria of* Streptococcus *genus from April to November at the stands tested

	Terms-month (cfu/m^3)							
	April	May	June	July	August	September	October	November
stand I	14	365	18920	950	100	180	28	17
stand II	8	105	1232,5	50	5	3,5	12	4
stand III	69	31,5	24	3	29	6	29	3

Neither for the bacteria of the genus *Enterobacteriaceae* nor for the genus *Streptococcus* there are any standards appointing permissible levels of these bacteria in the air. The research carried out in German composting plants indicated much higher level of microorganisms. According to the report of Böhm (1998) the count of *Escherichia coli* in the composting plant reached even 2400 jtk/m^3 of air.

The results obtained indicate that the most microbial air pollution with bacteria occurred in summer months as well as in early autumn. Also Nowak et al. (1997) reported the most count of microorganisms in the air in warmer times of the year.

From the research we can conclude that specific microorganisms are useful indicators for the estimation of the influence of landfills on the microflora content in the air. Although *E. coli* and fecal streptococci are not taken into consideration in Polish Standards, their presence may indicate microbial airborne contamination. According to Piekarska and Traczewska (2002) assuming the total count of microorganisms to be an indicator of airborne

contamination excludes the possibility of finding pathogenic threat. That is why the particular attention should be given to specific microorganisms, occurring only at a given area, since their presence allows us to appoint precisely the range of action of public utilities objects on the air quality. The decrease in count of specific bacteria in the air proceeds much faster than the fall in the total bacteria number. The phenomenon is explained by higher sensitivity of specific bacteria to environmental conditions than that of saprophytic microflora normally occurring in the air.

Conclusions

1. The count of the bacteria tested in air was different in selected research points and depended also on the time of the year and atmospheric conditions.
2. Stands 1 and 2, situated directly at the municipal landfill site, were the most exposed to microbial contamination with the bacteria of the genus *Streptococcus*. It can pose a serious threat to the health of landfill workers.
3. The highest degree of airborne pollution with *Escherichia coli* was observed at the place compost piles turning.

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