

## THE INFLUENCE OF SEWAGE SLUDGE COMPOSTING PROCESS ON THE REDUCTION OF FECAL STREPTOCOCCI

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**Key words: composting, fecal streptococci, sewage sludge**

### Introduction

Due to the increasing use of sewage sludge in agriculture in the last few years their hygienic properties are getting incredibly important. Sewage sludge added to composted biomass may be a source of pathogenic microorganisms, and thus contribute to environmental pollution. Among indicator microorganisms used for the estimation of sewage sludge hygienization during its conditioning (for example in composting process) we can distinguish fecal streptococci of D-group. They are relatively harmless comensals of human and animal alimentary tract. Only *Enterococcus faecalis* and *Enterococcus faecium* can be a health hazard, particularly because of their resistance to antibiotics (Wieczynska et al. 2001). Fecal enterococci are also characterized by relatively high resistance to unfavorable environmental conditions, including high temperature (Cools et al., 2001, Kumar et al., 1999).

### Material and methods

The research was carried out during sewage sludge composting with an addition of sawdust and straw in three time periods: in autumn, spring and summer. In autumn and spring compost samples were taken from three levels of the pile: top, middle, and bottom, in time intervals of a dozen days or so. In summer special carriers were placed at three levels: top, middle, and bottom in the maturing pile, each of which contained 2 ml suspension of fecal streptococci with a concentration of  $10^9$  MPN/ml.

The carriers were removed every dozen days or so and microbiological analyses were made. Fluid medium with glucose and azide as well as selective solid medium with canamicine, esculine, and azide was used for fecal streptococci determinations. Incubation was performed in  $37^{\circ}\text{C}$  for 48 hours.

The number of bacteria tested was determined on the ground of the most probable number method using the Mc Crady tables. The results were then analysed statistically using the Statistica program.

## Results and discussion

The results of sewage sludge microbiological research subjected to composting process are illustrated in Figures 1,2,3, and in Table 1.

Fecal streptococci were used to the studies because of their higher resistance to unfavorable environmental condition in comparison with *Escherichia coli*, *Salmonella*, and other pathogens, which was confirmed in the reports by Jepsen et al (1997). Similar results were obtained by Shaban, who indicated that elimination of *E. coli* and *Salmonella* occurred after 14 days of composting, and the reduction of fecal streptococci of D-group amounted to 62% only after 73 days (Shaban 1999).

In the personal study in the autumn period the inactivation of fecal streptococci proceeded slowly. Daily decrease in the bacteria number ranged from 0.04 log in the top part to 0.07 log in the middle part. The survival rate varied from 103 days at the middle layer to 185 days at the top layer (Tab. 1).

In spring the daily decrease in count was similar to the autumn period and ranged from 0.06 log in the middle and bottom layers to 0.07 log in the top layer. The time needed to the total inactivation of fecal streptococci calculated on the base of regression lines varied from 106 days in the top layer to 130 days in the bottom layer (Tab. 1).

The slow inactivation rate of streptococci both in autumn and spring was probably connected with low temperatures generated during the composting process. In the autumn period the temperature did not exceed 18<sup>0</sup>C, while in the spring period the temperature at the beginning of composting process amounted to 19<sup>0</sup>C, then fell rapidly to 7<sup>0</sup>C and again increased gradually to 27<sup>0</sup>C (Fig. 1, 2)

The results of the analyses showed that the most favorable conditions in respect of hygienic safety occurred during the summer. Faster bacteria elimination rate was observed then. The microbial inactivation time calculated on the base of regression lines varied from 101 days at the top and middle layer to 106 days at the bottom layer (Tab 1).

Both in the summer and in the winter the most unfavorable conditions for the full hygienization of composted material occurred in the bottom layer of the pile.

Tab.1 Regression lines illustrating the survival rate of fecal streptococci of D-group in the compost pile in particular periods

Pile layer	autumn period	spring period	summer period
top	$y = -0,04x + 7,38$ x = 185 days	$y = -0,07x + 7,76$ x = 106 days	$y = -0,06x + 6,07$ x = 101 days
middle	$y = -0,07x + 7,18$ x = 103 days	$y = -0,06x + 7,08$ x = 118 days	$y = -0,06x + 6,05$ x = 101 days
bottom	$y = -0,05x + 6,95$ x = 139 days	$y = -0,06x + 7,31$ x = 130 days	$y = -0,05x + 5,30$ x = 106 days

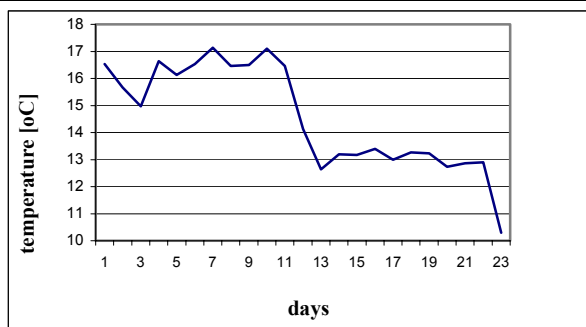


Fig. 1 Temperatures of the composted pile in the autumn period

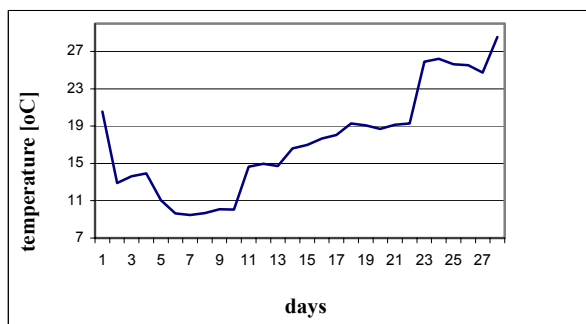


Fig. 2 Temperatures of the composted pile in the spring period

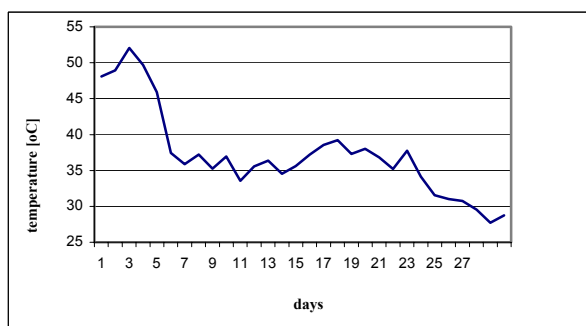


Fig. 3 Temperatures of the composted pile in the summer period

## Conclusions

1. The inactivation of fecal streptococci during sewage sludge composting process proceeded slowly.
2. In the spring and summer period the elimination of tested bacteria proceeded the most slowly in the bottom layer of the pile.
3. The fastest reduction in indicator bacteria was noticed in the summer period.
4. The thermophilic phase, that is essential for the proper hygienization of composted sewage sludge, was not observed in the autumn and spring.

## References

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