THE EFFECT OF COMPOSTING OF POULTRY EXCREMENTS ON THE SURVIVAL OF MODEL HELMINTH EGGS

Papajová, I.[1], Juriš, P.[1], Szabová, E.[1], Sasáková, N.[2], Venglovský, J.[2], Šefčíková, H.[1] and Vargová, M.[2]

[1] *Parasitological Institute of the Slovak Academy of Sciences, Hlinkova 3, 040 01 Košice, Slovak Republic; E-mail: papaj@saske.s;* [2] *University of Veterinary Medicine, Komenského 73, 041 81 Košice, Slovak Republic*

SUMMARY

The process of aerobic composting of poultry excrements was optimised under running conditions in composting pits by the changes in physical-chemical characteristics of the substrate. In composting piles, which were mixed so as that the resulting ratio of C:N would be above 15:1 and were regularly aired, the effect of aerobic composting of poultry excrements and straw on the survival and development of model non-embryonated *Ascaris suum* eggs was observed. Due to the changes in the pH value, C:N ratio, temperature up to 70°C, a decrease in the concentration of NH_4^+ as well as in the total nitrogen , 98.5±3.65 % of eggs were devitalised as soon as on day 4 from the beginning of composting. A total devitalisation of non-embryonated *A. suum* eggs occurred between day 4 and 7 of composting. Thus the risk of the dissemination risk, survival and potential spread of endoparasitic germs in the environment can be eliminated.

Keywords: composting, poultry excrements, *Ascaris suum* eggs, survival

INTRODUCTION

Animal manures have been used effectively as fertilizers for centuries. Poultry manure has long been recognized as perhaps the most desirable among these natural fertilizers because of its high nitrogen content. In addition, manures supply other essential plant nutrients and serve as a soil amendment by adding organic matter. The most serious problem is the liquidation of these organic wastes. Utilisation and disposal of wastes has been the subject of many investigations, which have described contamination of the environment with emissions, toxicity of treated wastes to plants, but also potential survival and spreading of pathogenic agents (Bernal et al., 1993; Juriš et al., 2000; Papajová et al., 2002 and others). In recent years, composting has been presented as an environmental friendly and sustainable alternative of how to manage and recycle organic solid wastes, with an aim to obtain a quality organic product to be used as organic amendment in agriculture (Pagans et al., 2006). The aims of this study was (i) to optimise the process of aerobic composting of poultry excrements under running conditions in composting piles by the changes in physical-chemical characteristics of the substrate and (ii) to monitor the effect of aerobic composting of poultry excrements and straw in composting pits on the survival and development of model non-embryonated *Ascaris suum* eggs.

MATERIAL AND METHODS

Poultry excrements and straw were used at the experiment. Basic characterisation of these materials is given in Table 1. Excrements collected from the poultry farm and straw were mixed and 6 piles (H1-H6) were built (1.5 m high, 5 m long and 2 m wide). The surface of the piles was not covered with any material to imitate natural conditions. The composting process at the piles proceeded from 17-day (H4-H6 piles) to 33–day (H1) retention time and in the thermophilic temperature range (to 70°C). Piles were periodically dug up (shovelled). The following changes in physical and chemical properties of the stored wastes were monitored: the pH, dry matter (DM), organic matter (OM), ammonium ions (NH_4^+), total nitrogen (N_t) and C:N ratio. The methods used corresponded to the STN 465 735. The C content was calculated according to the content of OM by the method of Navarro et al. (1993), and the C:N ratio was calculated.

Samples of poultry faeces were parasitologicaly examined using flotation techniques (Jurášek, Dubinský et al., 1993). We used the "artificial contamination of trough" with non-embryonated *A. suum* eggs approach to make sure that there was a sufficient number of positive samples in our observations. Eggs were inoculated into polyurethane carriers, prepared according to Plachý and Juriš (1995), at a dose of 1000 eggs per carrier. The carriers were placed to perforated PET bottles (50 ml) and introduced into a composting pile (H3). After the exposure in the pile, samples for parasitological and physical and chemical examination were collected after 0, 1, 2, 4, 7, 9, 14, 17 and 24 days of composting. Three samples were taken and analysed at the given sampling intervals. The controls with eggs were incubated in distilled water. Significance of differences between experimental and control groups were determined using Dunnet's multiple comparison test at the levels of significance of 0.05; 0.01; and 0.001 (Statistica 6.0). The physical and chemical properties of the organic material, as well as the number of devitalised non-embryonated *A. suum* eggs were expressed as the mean values±standard deviation ($\overline{x}$ ±SD).

Table 1. Physical and chemical properties of the basic (leasing) materials

	Straw	**Poultry excrements**
pH*	7.01	8.43
DM (%)	92.55	44.67
OM (%)	93.34	77.99
IM (%)	6.66	22.01
NH_4^+ (g.kg^{-1} DM)	<0.10	1.76
N_t (g.kg^{-1} DM)	9.80	36.93
C:N	48.52:1	11.53:1

*pH value in aqueous extract which was obtained by mechanically shaking the samples for 1 h with double distilled water at a solid: water ratio of 1:10 (dry weight/volume).
DM – dry matter, OM – organic matter, IM – inorganic matter, NH_4^+ – ammonium ions, N_t – total nitrogen

RESULTS AND DISCUSSION

Composting piles were mixed based on the laboratory results of the experiment. Piles were mixed so that the resulting ratio of C:N would be above 15:1 and regularly aired. The temperature changes during composting are show in Fig. 1. The physical and chemical properties of the composting material are given in Fig. 2–5. However, composted material contained a more humified (stabilised) OM compared with the non-composted poultry manure. Our results correspond with the results of Tiquia and Tam (2002). Composting of poultry manure converted the soluble nutrients to more stable organic forms, thereby reducing their bioavailability and susceptibility to loss when applied to crop fields.

Poultry faeces were also parasitologicaly examined. No parasites were find at the symplex, therefore we used the "artificial contamination of trough" with non-embryonated *A. suum* eggs. These eggs are most resistant to environmental factors amongst the helminth eggs Thus they were chosen as the model. *A. suum* eggs were totally devitalised as early as between day 4 and 7 of composting process (Table 2) due to the high temperature and changes in physical and chemical properties of the composting materials during composting of poultry manure with straw.

Table 2. Damage of *A. suum* eggs during composting of poultry excrements

Exposure (days)	Damaged *A. suum* eggs ($\overline{x}$ %±SD)
0 (control)	16.02 ± 2.61
1	28.16 ± 1.18
2	58.26 ± 4.63*
3	69.11 ± 7.22**
4	98.50 ± 3.65**
7	100**
9	100**
14	100**
17	100**
24	100**

$\overline{x}$ – mean values, SD – standard deviation, *Significance at the level $P<0.01$, **Significance at the level $P<0.001$

We can conclude – from a parasitological point of view – that thermophilic aerobic composting had a lethal effect on the viability of helminth eggs. This way of treatment is thus not associated with a risk of dissemination, survival and potential spread of developmental stages of endoparasites to the environment via composted organic wastes. Output from the aerobic composting of poultry excrements and straw can be used as organic fertiliser.

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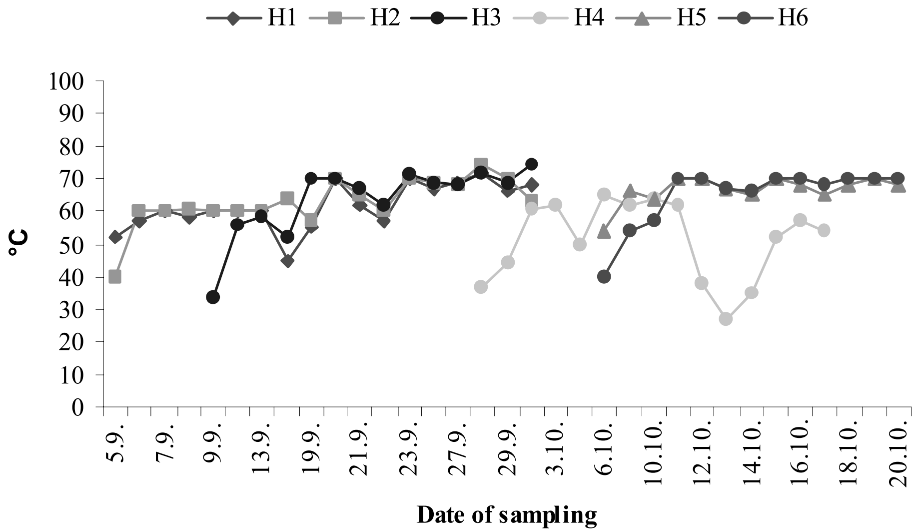

Figure 1. Pile temperature changes during composting

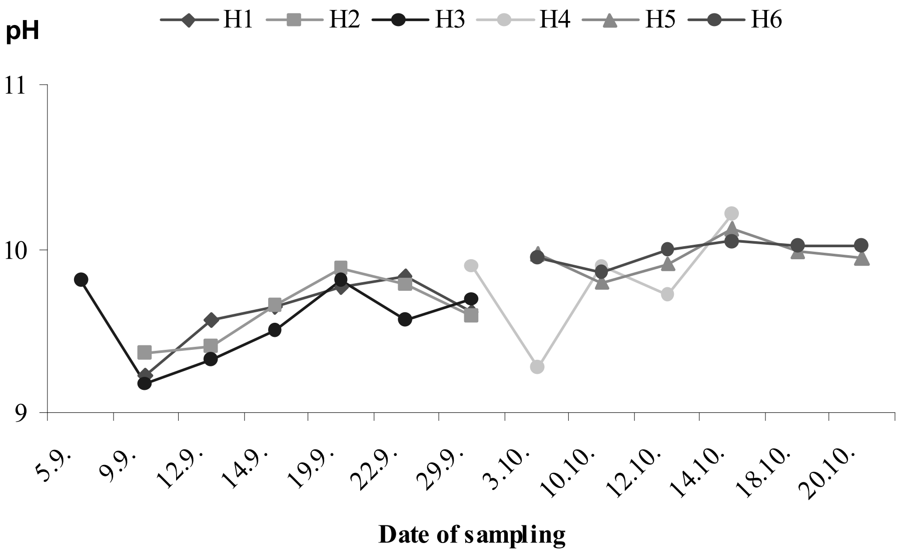

Figure 2. Changes in pH of organic material during composting

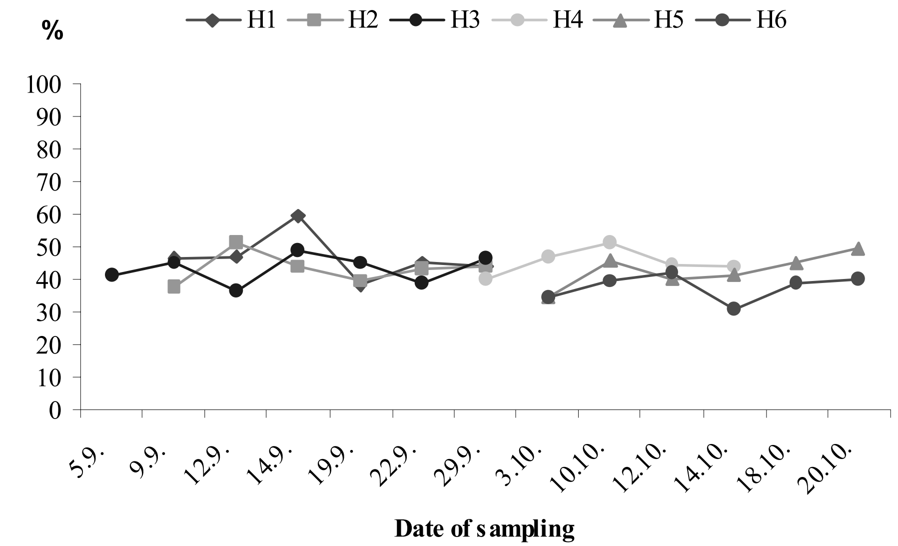

Figure 3. Changes in DM of organic material during composting

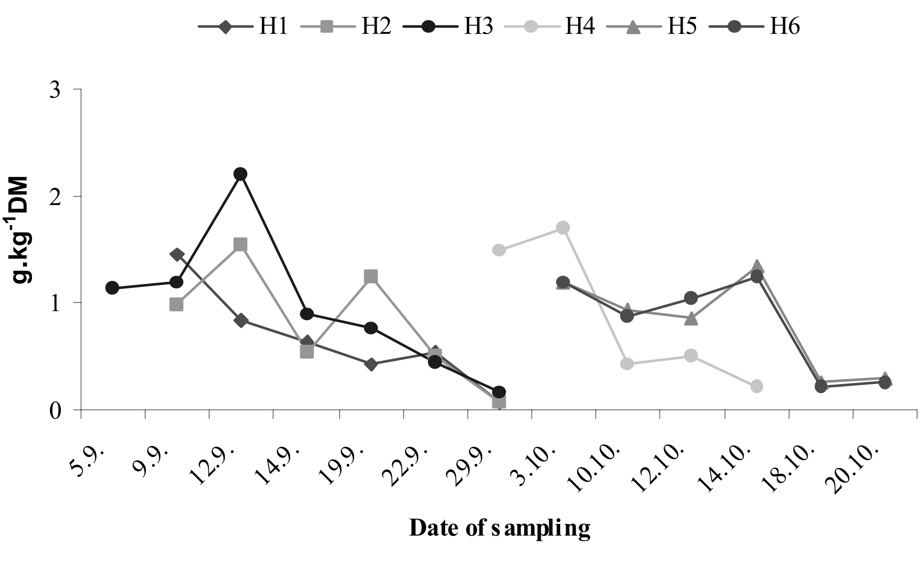

Figure 4. Changes in NH_4^+ content of organic material during composting

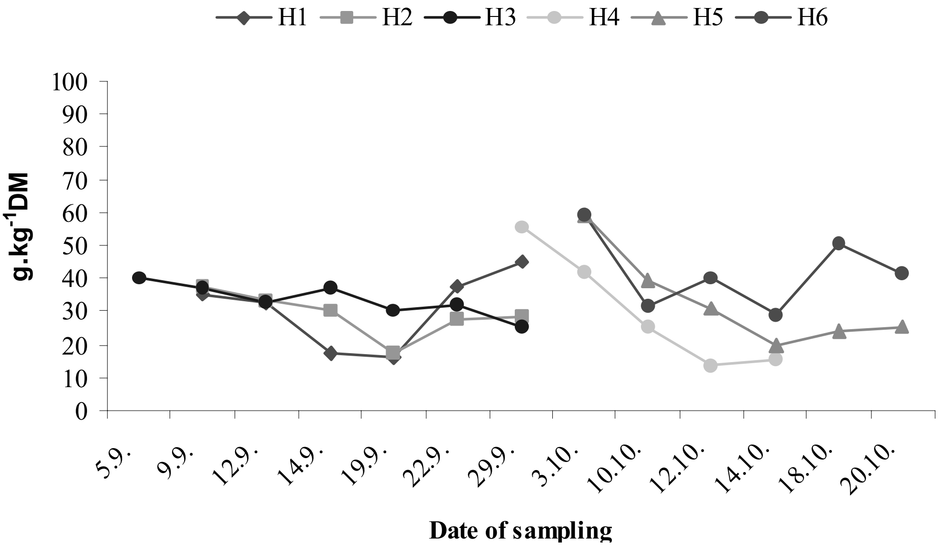

Figure 5. Changes in N_t content of organic material during composting

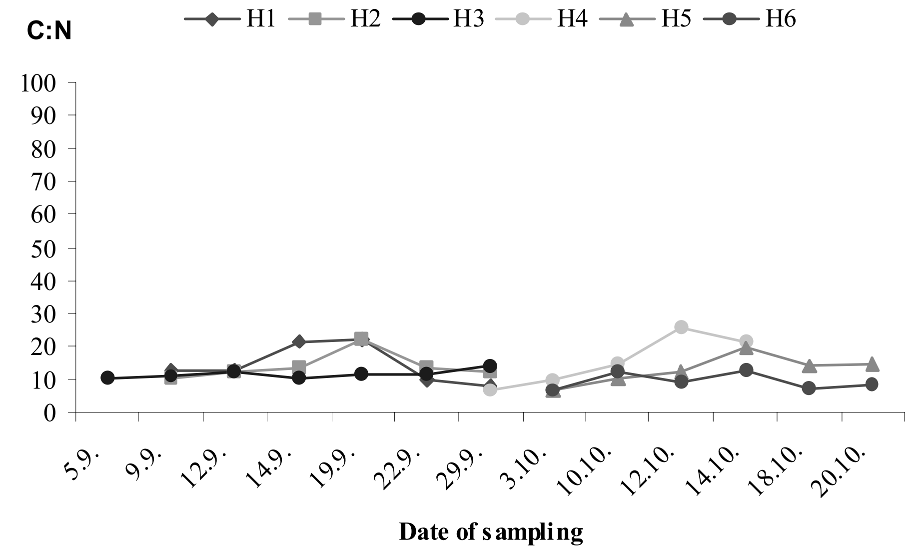

Figure 6. Changes in C:N ratio of organic material during composting