TEMPERATURE AND pH MONITORING IN WINDROWS FROM ANIMAL FACILITY WASTE COMPOSTING

[*Monitoramento da temperatura e pH de leiras de compostagens formadas com resíduos sólidos de biotério*]

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ABSTRACT - The objective of this study was to monitor temperature and pH in composting windrows constituted of rabbit, guinea pig, mouse and hamster wastes. Wastes from these laboratory animals were mixed to cotton wastes to produce 721.65 kg of composts. There were constructed 6 composting windrows and they were monitored daily for temperature and pH. Composts were watered daily until humidity level was near 55%. The compost piles were turned every 15 days. All the windrows passed through a thermophilic phase followed by a mesophilic phase, and maximum temperature was near 60°C. The pH values ranged from 6 to 8 in most of the windrows. In conclusion, characteristics of the compost studied such as humidity, pH, color and absence of foul odors makes it suitable for agricultural use.

Keywords: Laboratory animals, environmental pollution, waste management.

RESUMO - Teve-se por objetivo monitorar a temperatura e pH de leiras de compostagem formadas a partir de dejetos de coelhos, cobaias, camundongos e hamsters. Foram misturados resíduos de animais de laboratório e resíduos de algodão, para uma quantidade de 721,65 kg. Foram montados 6 leiras de compostagens, as quais foram monitoradas diariamente quanto a pH e temperatura. As compostagens foram molhadas diariamente, até atingirem umidade próxima a 55%. As reviragens das compostagens foram realizadas a cada 15 dias. Verificou-se que em todas as compostagens ocorreu uma fase termofílíca e outra mesofílica, com temperatura máxima próxima a 60°C. Os valores de pH oscilaram dentro da faixa de 6 a 8 na maioria das leiras. Conclui-se que o composto estudado apresentou características desejáveis para a agricultura, como umidade, pH, coloração e ausência de maus odores.

Palavras-Chave: Animais de laboratório, poluição ambiental, tratamento de dejetos.

INTRODUCTION

Composting is the exothermic aerobic bio-oxidation of a heterogeneous organic substratum at solid state. This process produces CO_2 and water, releases mineral substances and produces stable organic matter. Because this is a biological process, aeration, nutrient availability and humidity are key factors that affect organic matter degradation. Temperature is other important factor because this is increased by the biological activity in the compost and affects biodegradation speed and pathogen reduction. The nutrients, in special carbon and nitrogen, are crucial for bacterial growth (Bettiol & Camargo, 2000). According to Pereira Neto (1996), composting involves two phases: a thermophilic (45 to 65 ºC), characterized by the maximum levels of microbiological activity that degrades and kill undesirable pathogens in the compost, and a maturation phase in which the compost is in fact produced and humidified. The production of a compost that can be applied on soil requires that temperature inside the windrows is kept above 55 ºC for 3 consecutive days to effectively reduce pathogens to acceptable levels. In order to explore the potential use of animal wastes as compost ingredient and identify undesirable characteristics that must be corrected in this matter, It was aimed in the present study to monitor temperature and pH in the composting windrows formed with wastes from animal care facilities.

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MATERIAL AND METHODS

The solid residues produced in an animal care facility consisted in feces, urine and wood chip bedding of rabbits, guinea pigs, mice and hamsters. The wastes were first separated for each species and mixed at different proportions to cotton wastes to reach a C:N ratio close to 1. It was mixed 500 Kg of solid wastes from the 4 species studied with 221.65 kg of cotton wastes to produce 721.65 kg compost, as shown in Table 1.

There were 6 composting windrows filled with similar waste composition. The materials were deposited in windrows for aerobic composting. The top and the sides of more vulnerable windrows were protected with jute sacks to prevent the compost from being dried up by sunlight exposure. The windrows were monitored daily for temperature and pH using a thermometer that read from 0 to 220 °C. The composts were watered daily with tap water until they had humidity level close to 55% (Pereira Neto, 1996). We turned the composting piles every 15 days over the experiment that lasted 100 days.

This study was approved by the Committee on Animal Research Ethics of UFMG, protocol 183/07.

RESULTS AND DISCUSSION

Temperature in the composting experiments is shown in Figure 1.

Table 1. Amount of wastes used in the aerobic composting experiment Experiment Wastes

Experiment	Wastes (kg)				
	Rabbit	Mouse	Guinea pig	Hamster	Cotton
Composting	30.5	125.5	330.9	13.1	221.65

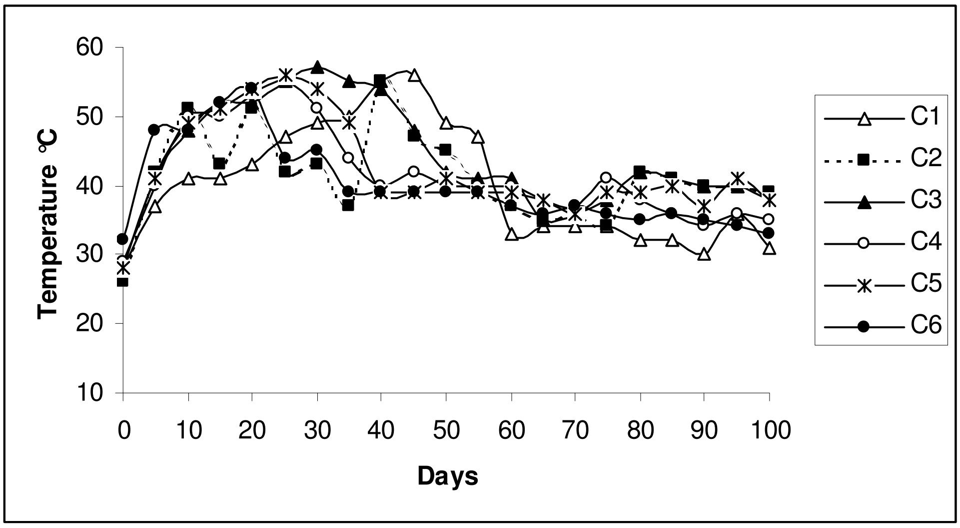

Figure 1. Temperature variation in the composting windrows (1 to 6) over a 100 day experiment.

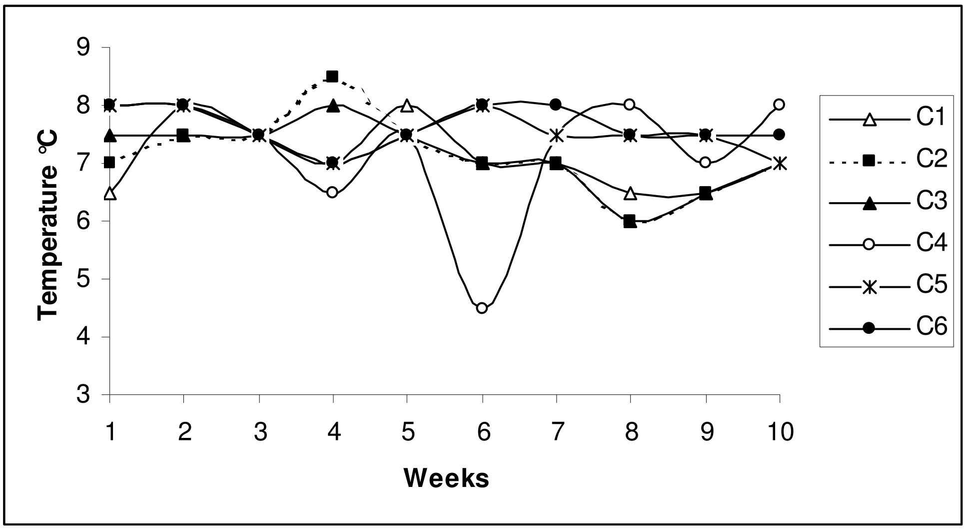

Figure 2. pH variation in the composting windrows (1 to 6) over a 100 day experiment.

All the windrows had a thermophilic phase followed by a mesophilic phase. The maximum temperature of around 60ºC was reached near the 25th experiment day. Similar results were reported in other studies (Hanajima, et al. 2001; Thambirajah et al., 1995; Georgacakis, 1996). However, Usmani et al. (1996) obtained higher temperature peaks that ranged from 65 to 78 °C. Temperature variations from one to another study is likely associated to the nature of the composting substratum. Despite this, the exothermic metabolism of the microorganisms causes a rapid mass heating during aerobic fermentation. Each microorganism group is specialized and develops within an optimal temperature range. Therefore, conditions that promote the maintenance of an optimal temperature for these microorganisms are fundamental for composting success. The thermophilic phase is characterized by a rapid decomposing reaction whereas the mesophilic phase consists in slow decomposition of organic matter (Igue, 1984; Paul & Clark, 1989; Pereira Neto & Stentiford, 1992). The microbiological activity naturally enhances temperature in the waste mixture that reaches 60-65 °C, a range that is maintained for several days and eliminates waste pathogens (Hay, 1996). An important data is that the temperature that was obtained has not exceeded the limit temperature established in other studies, which could be lethal to the process. The internal temperature of the windrows was controlled by the aeration promoted by periodical manual turning of the piles. Pereira Neto (1996) reports that the mean ideal temperature for composting is near 55 ºC, and temperatures beyond 65ºC must be avoided because eliminate the mineralizing microorganisms that degrade organic residuals. This reinforces the importance of temperature control inside the windrows. Besides temperature control, Kiehl (1985) states that air abundance provides better composing conditions, avoiding foul odors and the accumulation of flies. All the composts produced were stable within around 100 days of experiment. This stabilization is achieved when windrow temperature becomes close to room temperature (Kiehl, 1985).

The pH values recorded over the experiment are shown in Figure 2.

The composts initially had acidic pH (5 to 6) provoked by the production of organic acids and carbonic gas; however, these elements likely reacted with the bases released from the organic matter thereby neutralizing and alkalinizing the medium (8 to 8.5) by the end of the process (Reis et al., 2004). In the present study, pH oscillated from 6 to 8 over the experiment, except for windrows 2 (pH > 8) and windrow 4 (pH< 5) (Fig. 2). The low pH in windrow 4 was likely caused by accumulation of existent organic acids. These acids were metabolized processed over composting, which increased pH value. An important point is that pH was 8 at the end of composting. This suggests that the compost was stabilized and did not require liming. The agricultural use of and acidic compost can promote heating because of microbial respiration as well as localized and temporary acidification of soil, thereby compromising root development and vegetal production (Jahnel et al., 1999). Therefore, neutral to alkaline fertilizers produced by composting are better used by the plants, and their action on soil acidity and salinization will decrease substantially. Stabilized composts usually have pH values beyond neutrality. Composting studies using other waste types also found pH within the alkaline range.

CONCLUSIONS

The results achieve to sustain the importance of monitoring windrow temperature and pH over the entire composting process. Fails in this control can lead to undesirable quality of the compost, which can become harmful to the environment, acquire foul odor and attractive to vectors.

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