

Householders perception of the on-site food waste composting process

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Abstract: Purpose: investigate the householders perception of the on-site food waste composting process in a community located in the semi arid region of Brazil characterized by low levels of sanitation services. Methods: The information for the residents socioeconomic characteristics and waste management were obtained from local observations and interviews. The residents received a low cost (US\$ 5.80) composting kit containing a small composter and one folder with instructions about the composting procedures. The perception of smell intensity, presence of vectors (mosquitoes, flies, rats), and the efforts made to separate the organic waste and operate the composter were recorded in a checklist by the residents in a daily basis. At the end of the monitoring period (40 days), an open and semi-structured questionnaire was applied. Results: The residents highlighted several points such as the reduction in the amount of solid waste to be collected, the use of the produced compost, and the fact that the composter was easy to handle, inexpensive and easily replicable. The low cost and the small area occupied by the composter were important factors for the low income families with their small properties as well. Conclusions: The residents participation was voluntary, however, they were stimulated thru information about the segregation and food waste composting, besides the donation of composters and the possibility of compost use on their vegetable and/or flower gardens. These conditions appear to be essential to improve the strategies for the implementation of home composting programs on a large scale.

Keywords: Composting, food waste, householders perception, organic waste

1. INTRODUCTION

A new lifestyle with changes in production, consumption patterns, and waste generation is necessary for humanity. The establishment of these new behavioral and cultural patterns depends on education work and awareness and should be the task of the current and next generation. It is urgent to design programs that allow the establishment of a solid waste management strategy consistent with the preservation of the environment. These programs should prioritize the minimization of waste production, maximizing the reuse and environmentally friendly recycling, the promotion of systems for treatment and wastes disposal compatible with environmental preservation, and coverage extension of the collection and disposal services. However the deployment of solid waste management programs face serious difficulties because they involve high costs, bureaucracy and lack of qualified human resources, mainly in developing countries. Therefore, the hope to change this scenario lies in the actions at the local level, ie, neighborhoods and communities.

Approximately 20 million tons of waste are produced annually in Brazil. This is a country of contrasts socioeconomic and significant levels of poverty, which implies great challenges for proper solid waste management. The most common way to dispose solid waste is landfilling, but, unfortunately, the second is in the open dumps. Among of the total organic waste collected daily, only 1.0% is destined for centralized composting units. The food waste that comes from food handling, meals preparation and leftovers could be separated and processed by composting. It is well documented that decentralized home composting contributes to a waste reduction at source, besides minimizing CO₂ and methane emissions from landfills. It is also a low cost process that does not require large investment in facilities and transportation [1-2].

Home composting is a voluntary activity, so it is necessary to motivate families to engage in the practice. The central problem is the citizen capability recovery to decide upon the ways for its own development, the establishment of concrete actions, preservation of natural resources in your neighborhood or in your community. Personal attitude resulting from the individual perceptions about some activity aspects such as good or bad, helpful, pleasant are the main determinant for active engagement. Thus, environmental awareness and technical expertise to the management of composting process are important and effective incentives for efficient solid waste management at the local level [1,3].

Recently, topics about food waste home composting and the householders perception, response and behavior have been studied [2,4-6]. Therefore, the aim of this study was to investigate and analyze the householders perception of the on-site food waste composting process in a community located in the town of *Santo Domingo, Bahia*, Brazil. This town is situated in the semi arid region of Brazil, has low human development index (HDI) and is characterized by low levels of sanitation services. The inhabitants have per capita income inferior to US\$ 2.00 per day. *Santo Domingo* is situated in the semi arid region of Brazil, has low human development index (HDI) and is characterized by low levels of sanitation services. The pluviometric precipitation does not exceed 600 mm per year and the average annual temperature is 26°C. The economy is based on agriculture highlighting the sisal production. The municipal solid waste collection is performed once week, but in rural areas there is no collection of solid waste which results in the occurrence of disposal in dumps with severe consequences to environment and public health.

2. METHODS

The qualitative and quantitative information for the socioeconomic characteristics of residents and waste management were obtained from local observations and interviews. To obtain the gravimetric composition and per capita waste production, community was instructed to segregate their waste into categories such as: dry, humid and worthless materials. Plastic bags (5.0L) were properly identified and distributed to package the waste produced in each residence. These plastic bags containing the waste already segregated into categories were collected door to door. Packs were weighed individually on a 40kg capacity digital balance. However, before weighing, each bag was opened to confirm that the waste segregation into categories had been properly carried out. Representative samples obtained by the quartering (2.0 kg) of wet waste were sent for moisture content analysis, pH value, total and volatile solids.

The residents received a composting kit (Figure 1) containing a small composter and one folder with instructions about the composting procedures (Figure 1). The small composter consists of three 20 L plastic bins, stacked one above other and they occupy a 40 cm² floor area. The top two bins have small holes for contents aeration and the lower bin has a drain on the base to collect the leachate. The materials price to make the small composter was about U\$ 5.80. The food waste was placed in the upper bin daily, covered with structuring material (wood chips) and mixed once a week, manually with a large spoon. When the upper bin was filled up, it was replaced by the middle bin and the process started again with new woodchips. The perception of smell intensity, presence of vectors (mosquitoes, flies, rats), and the efforts made to separate the organic waste and operate the composter were recorded in a checklist by the residents in a daily basis. At the end of the monitoring period (40 days), an open and semi-structured questionnaire was applied. Furthermore, it was questioned the intention to incorporate the food-waste composting in the households routine and the use of the produced compound in gardening activities and vegetables cultivation. A scale of 1 to 5 was assigned to represent the perception of the inhabitants about the impact (factors of gravity) of each criterion evaluated.



Fig.1 Kit composters

3. RESULTS

The average quantity of food waste produced by each inhabitant was 0.07 kg per day. The average percentage gravimetric composition found for the dry categories, humid and worthless materials were respectively 42%, 33% and 29%. The moisture content was equal to 76% and 84% of STV on a dry basis. These values are similar to the results found by Kumar *et al.* (81%) [7] and Colon *et al.* (74,5%) [8].

After a brief training, the community did not present difficulty to properly segregate the solid waste. Furthermore, it was observed that in the residences there was 10 m² yard area. In most households, these areas are used for growing vegetables or ornamental plants. The possibility of using the final compound in these activities was crucial to the increased interest of the community. Another important aspect is that these people had the habit of segregating waste motivated by the nuisance of the waste collection absence by the municipality. Tucker and Speirs [9] show that previous experience reduces negative perceptions regarding composting, strengthens the intentions and expands responsible management actions of solid waste. In our study it became clear that the previous practice of waste segregation facilitated the acceptance and incorporation of home composting by the residents, even though these individuals presented low level of education.

In the majority of the cases, the composter reached mesophilic temperature (44°C) after five days. The values of the temperature of the mixture seem to indicate that a small amount of food-waste may have been a limiting factor for achieving thermophilic temperatures. Arrobas *et al.* [10] reports that rarely temperatures reach values higher than 45°C in domestic composters. After this time, there was a reduction in the temperature remaining between 37 and 35°C for approximately 10 days. Only at the end of 40 days, the mixture temperature equaled room temperature. This observation indicates reduction of microbial activity and the end of the degradation of the organic matter.

During the first week, 50% of the residents reported unpleasant odors, and the presence of flies and mosquitoes. However, this nuisance was recorded as an intensity of degree 3 (on a scale of 1 to 5), therefore this could be considered tolerable. According to Laos *et al.* [11] the release of volatile compounds takes place in the first 20 days of composting, and it tends to drastically reduce with the progress of the process. After this period, these troublesome aspects disappeared in our study. Certainly, community inexperience in handling the composting process has contributed to the emergence of these problems. Probably occurred compression of the mixture due to the low number of turnings held weekly in the initial period. This improper handling favored increasing of the moisture and anaerobic digestion and, consequently, production of bad odor production and leached. However, the amount of leachate generated can be considered negligible (150 mL per cycle). The solution for these problems is important because the presence of flies, the production of leachate and the presence of bad odor are among the biggest drawbacks and are some of the main reasons for withdrawal of home composting [2].

Several aspects were considered as benefits after the practice of home composting. The residents highlighted the reduction in the amount of solid waste to be collected, the use of the compost produced, and the fact that the composter was easy to handle, inexpensive and easily replicable. Besides this, they could develop more environmental awareness and learn throughout the study. The level of acceptance was high as the inhabitants of eleven houses expressed the intention to continue to use the process. The low cost and the small area occupied by the composter were important factors considering the low purchasing power and the small free areas on the inhabitants houses.

The application of the questionnaire associated with informal conversations between the researchers and the inhabitants during the research were relevant to encourage community behavior and strengthen responsible attitude in the

management of solid waste. In addition, residents of two houses took the initiative and built similar domestic composters to those used in the project, in order to deliver to families who lived in other communities. Social influence stimulated the adoption of home composting in these communities probably due to the problems experienced by the population before joining the practice.

4. CONCLUSIONS

The research allowed to conclude that actions at the local level with a high degree of community involvement can help to solve important global issues. Therefore, the implementation of programs in which people in their neighborhoods or homes are protagonists in the proper management and disposal of its own waste is possible. The residents participation was voluntary, however, they were stimulated thru information about the segregation and food waste composting, besides the donation of composters and the possibility of compost use on their vegetable and/or flower gardens. These conditions appear to be essential to improve the strategies for the implementation of home composting programs on a large scale.

While the evaluation period was relatively short, the high acceptance of the residents in relation to home composting, low dropout to the program and even the joint to copy the composting model developed in the program are continuing evidence of the success of the program.

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