Modern Environmental Science and Engineering (ISSN 2333-2581)
June 2018, Volume 4, No. 6, pp. 553-555
Doi: 10.15341/mese(2333-2581)/06.04.2018/009
Academic Star Publishing Company, 2018
www.academicstar.us

Evaluation of the C/N Ratio in Anaerobic Digestion of Organic Restaurant Residue

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Abstract: The production of urban solid waste is increasing, and, in Brazil, the organic waste comprises its majority. Proper treatment or disposal is much less applied to organic wastes, although these residues have the potential to generate biogas and biofertilizer. In this way, the C/N ratio was evaluated before and after the anaerobic digestion of the organic waste from a restaurant to verify the potential of this residue for use in biodigestion and to evaluate the effluent for the use as a biofertilizer. An anaerobic biodigester with a useful capacity of 120 L was used in a semi-continuous system with a mesophilic temperature. The C/N ratio of the affluent ranged from 19.9 to 33.2 and the effluent from 9.4 to 11.9. The data found in the literature and those of this work for the C / N ratio are in agreement. Therefore, the studied residue has potential for direct use with no need of correction of the C/N ratio for the used process, and the generated compost demonstrated the possibility of its use in fertilization.

Key words: biodigestion, biofertilizer, degradable residue

1. Introduction

The inadequate destination of solid waste brings problems to the environment and to the population health, among these, organic wastes are the type of waste that least has received an adequate treatment or destination when compared to other solid urban waste such as metal, plastics and glass.

In Brazil, it is noteworthy that more than half the USW are of organic origin, [1], and that organic waste from restaurants have a significant contribution to these [2]. However, from the anaerobic digestion of this residue, the stabilization of organic matter and the production of biogas can be obtained [3].

The biodegradability of organic material is an important factor in biodigestion as it will influence the time of decomposition of the material and the transformation into biogas and biofertilizer. Therefore, the C / N ratio is an indicator of biodegradability in anaerobic digestion treatment. Carbon represents the energy material available and necessary for the activation of the cellular synthesis process and nitrogen, the basic material for the constitution of the synthetic cellular matter of the microorganisms [4].

Thus, it was intended to evaluate the C/N ratio before and after the treatment by anaerobic digestion of organic restaurant waste in order to verify the potential of this residue for use in biodigestion and the capacity of the compound generated as biofertilizer for this factor in question.

2. Material and Methods

The work was carried out in the Department of Chemical Engineering of the Federal University of Santa Maria (UFSM), Brazil.

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An anaerobic biodigester with a useful capacity of 120 L was used to treat the organic residue of a restaurant. The temperature was kept close to 30°C and the residue diluted in water at a ratio of 1: 3, the particle size was less than 10 mm [5] and then supplied to the biodigester. Feeding was done daily, as well as the collection of effluent, in the same volume of the feed.

The analysis of the C/N ratio were carried out at the Laboratory of Biotransformation of C and N (LABCEN) belonging to the Center of Rural Sciences of UFSM. Analysis of the C / N ratio of the tributary and the effluent were performed. Sample preparation was performed as described by the authors [6]. Three collections of the material were made, and the analyses were done in triplicate by the technique of dry combustion. The percentage of total carbon and nitrogen were determined in the CHNS series Elemental Analyzer (model FlashEA 1112, Thermo Finnigan, Milan, Italy).

3. Results and Discussion

The C/N ratio ranged from 19.9 to 33.2 for the affluent (organic restaurant waste, before treatment) and for the effluent (material collected at the biodigester outlet, after treatment) of 9.4 to 11.9. The mean and standard deviation can be seen in Table 1.

Table 1 C/N ratio data of the tributary and effluent.

Affluent			Effluent	
Parameter	Average	Standard deviation	Average	Standard deviation
C/N	23.7	0.3	11.0	0.1
	20.0	0.1	11.7	0.3
	32.8	0.7	9.5	0.1

The data of the C/N ratio for the affluent characterize the organic restaurant residue with potential anaerobic digestion treatment, since they are within the suggested range between 20 and 30 [7, 8]. Only the last average value was slightly higher, which can be justified by the heterogeneity of the residue used.

A study with biodigestion using organic material from commercial, horticultural, home and hotel marketing centers obtained a C/N ratio of 36.6 [9]. Thus, the authors adjusted to a C/N ratio of 25 in order to avoid damaging the formation of methane during the process.

This work obtained a greater decomposition compared to the work of the authors [9], whose C/N ratio varied in the five reactors followed by 12.1 to 21.1. The temperature may have been the influent factor in these data since this work used controlled temperature, close to 30°C while, the authors worked at room temperature, near 25°C.

In general, the higher the temperature, the greater the degradation of organic matter. In addition, a smaller particle size, independent of the pre-treatment process performed, increases the available surface area, resulting in an increased food availability for the microorganisms, and thereby increases the anaerobic biodegradability [10].

In addition, the values obtained for the effluent, in this article, characterize it as a bioresorbable biofertilizer [11] with C/N ratio varying from 18 to 10.

4. Conclusion

The C/N ratio indicated that the studied restaurant residue has the potential for direct use without correction of the C/N ratio in the treatment through biodigestion. The generated biocomposite, also showed to be able to be used as a biofertilizer.

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