BIBLIOGRAPHIC ANALYSIS OF THE MAIN ELEMENTS THAT INFLUENCE THE COMPOSTING PROCESS

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ABSTRACT

With the advancement of technologies, Agronomy plays a fundamental role in the adaptation of new knowledge, including composting, an essential technique for minimizing environmental impacts. Traditionally used in rural areas and in recycling centers, composting allows the reuse of organic waste, transforming it into fertilizer and reducing pollution. The growing generation of waste, driven by population and technological growth, requires efficient management of these materials. Composting, in addition to being an ancient practice, has economic and environmental benefits, such as increased soil productivity, waste reduction, and reduced pollution. This study aims to review the factors involved in the composting process, addressing its history, the main elements that favor its application, and its relevance to Agronomy as a sustainable and accessible practice in organic waste management.

Keywords: Composting. Organic Waste. Sustainability. Agronomy. Environmental Management.

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INTRODUCTION

With the evolution of technologies, Agronomy is an important science that studies the various conditions and proposals of the environment, adapting new knowledge about composting, as it is one of the techniques used as an instrument to minimize possible harm to nature in this research.

Traditionally, the practice is seen in rural areas and in waste recycling centers. For the first case, the farmer looks for a way to reuse the leftover material in some useful way, such as fertilizer made of organic matter. In the second case, they are social or administrative measures that must be taken in the interest of the population as a whole, containing the amount of material that still remains, since it is also a pollutant and needs to be stabilized. And when it comes to that, the possible benefits of composting are that it is an inexpensive technique and limits air pollution.

Food waste is part of human daily life. However, with the growth on a large population scale and the mass advent of new technologies, it is natural that good management of these technologies for modern times has to be evaluated (MILARÉ, 2007). Composting is an ancient technique carried out by the Chinese a long time ago (FERREIRA, et al., 1981).

The international declaration launched in 2016 by the United Nations Environment Program (UNEP), the Global Waste Management Outlook, calculated that 2 billion tons of waste are produced worldwide and that close to 50% do not have a congruent destination (UNEP, 2015).

The process of decomposition of organic matter, with the understanding of cycling, which occurs through the transformation into humus, contributes to the increase in soil productivity. In addition, it helps to reduce waste discarded by the world population, as there is better reuse of it, in theory, a more sustainable way of thinking about the environmental side and cutting expenses for storage and transportation in favor of compost.

It can be referred to as the process of biological, aerobic, and thermophilic decomposition, controlled and managed, of degradation of organic waste, which takes place in a more stable organic product, both chemically and biologically treated, for use in the agricultural environment (EPSTEIN, 1997).

Zhu (2007) emphasizes that attributes of the practice of composting include the recycling of elements of interest, the reduction of the initial volume of waste, the degradation of toxic substances and/or pathogens, as well as the generation of energy.

The interest and justification for wanting to study the theme were perceived in the literature findings as relevant importance of composting as an applied technique that can minimize the polluting problems used in rural areas and resources to maintain an increasingly productive and profitable scenario.

The objective of the study was to discuss the factors involved in the composting process through a literature review. The specific objectives were: to conceptualize the history of composting, the means and factors that contribute to its process, and finally, ideas and knowledge that allow the development of this technique and its use in Agronomy.

Therefore, this monographic work intends to work with the knowledge about the composting technique, its use, its contribution, due to this use and the cost as one of the most accessible in a globalized scenario that has been effective in its processing without causing damage to the environment, but minimizing the impacts caused.

MATERIAL AND METHODS

The methodology that was used in the work will be a bibliographic review, with a qualitative method addressing its concepts, ideas, objectives, and considerations, in which the reflection from the authors can mainly point to contextual changes that need to be reviewed.

Extinguishing 100% of waste generation becomes an impossible task, but there are many ways to reduce, control, and manage the impacts caused, considering that agricultural development must meet and adopt increasingly sustainable practices that will be the subject of this study.

About the methodology of the literature review, it can be referenced as follows:

> The Bibliographic Review is also called Literature Review or Theoretical Framework. The Bibliographic Review is part of a research project, which explicitly reveals the universe of scientific contributions of authors on a specific theme (SANTOS and CANDELORO, 2006, p. 43).

To carry out this study, the foundation relied on the electronic search in the academic websites of Agronomy, in the promotion, writing, and textual production according to the ABNT standards provided by the institution of IFSULDEMINAS, Machado Campus.

When making the structural planning of the content to be researched, it was sought in the main databases such as Google Scholar, Agronomy portal, SCIELO, published journals, articles, dissertations and theses that pay attention to the theme already defined here with the contents that could directly contribute to the promotion of this study.

The main descriptors to look for in the materials were: Agronomy, composting, and main techniques; all these words will be of paramount importance in the development of the work.

In short, qualitative research is an important reference according to the authors Rodrigues and Limena (2006, p. 90):

> When it does not employ statistical procedures or does not have, as its main objective, to address the problem through these procedures. It is used to investigate problems that statistical procedures cannot reach or represent, due to their complexity. Among these problems, we can highlight psychological aspects, opinions, behaviors, and attitudes of individuals or groups. Through the qualitative approach, the researcher tries to describe the complexity of a given hypothesis, analyze the interaction between the variables and also interpret the data, facts and theories.

After choosing the methodology, the work was used to select the materials for the construction of the work, the publications documented in 10 years between 2008 and 2018 were used, but with the contribution of the oldest works below 2008 for demonstrating the relevance of the research used with their methods, in which they fostered, above all, research related to the theme and objective of this work.

Soon after the selection of materials, it was necessary to do other readings that could contribute to the development of the research, to the bibliographic content and to the construction of ideas for the results and discussion of the authors.

Thus, the theme is of paramount importance for knowledge, aiming to carry out the entire investigation procedure to develop the written production of this monographic work.

HISTORY OF COMPOSTING

The environment is one of man's great concerns about its preservation, care and sustainability, however, over the years, the implementation of new technologies has contributed to this condition, minimizing impacts originated by man himself due to pollution, a type of pesticides used on land to conserve, but which generate problems in the soil, water and air (PIRES and FERRÃO, 2017).

With the trends and evolution of technologies, the emergence of composting has become one of the techniques that promote and control the destination of organic waste, in which there is a high rate generated by various sectors in Brazil, thus causing political, economic and social concerns for its disposal without harming the environment and the rural environment (RODRIGUES et al., 2015).

In short, the importance of composting can be mentioned in the main ideas as discussed in the literature:

> Composting is a simple and low-cost technique, probably the oldest biological treatment system used by man, having been used by ancient civilizations as a natural method of recycling nutrients, commonly present in the waste resulting from their daily activities (RODRIGUES et al., 2015, p.761).

The practice of composting is a very old art that has been applied for centuries and Albert Howard in 1920, conducting research that would support the rational form, and from another point of view, composting is defined "with a controlled decomposition process, in technical terms, it is the exothermic aerobic bioxidation of a heterogeneous organic substrate, in the solid state." (WOJAHN, 2016, p.28).

However, "The result of composting is the release of carbon dioxide, water, and the production, in the end, of a stable compost rich in organic matter." (WOJAHN, 2016, p.28).

In important considerations of Conama (resolution No. 375 of August 29, 2006) it mainly shows its products and derivatives how they should be disposed of without causing the degradation of the environment, and composting has helped in the direct process of valuing organic matter whether of urban, agricultural, industrial or forestry origin, it is denoted by its criteria for recycling organic waste, a factor that uses the technique to minimize the risks caused by this classified and distributed waste as described (BRASIL, 2006).

It is essential to mention that there is a legislation that establishes guidelines for reducing impacts on the environment, called the National Council for the Environment - CONAMA, and this study is necessary.

In other words, it is shown that composting is also mentioned by waste and/or its microorganisms such as fungi and bacteria as the main responsible for the degradation of organic matter, since the composting process will transform this material into something that can favor it in a fertile way (PIRES, FERRÃO, 2017).

According to

> An environmentally correct alternative regarding the disposal of organic waste is composting. This process can be defined as the process of biological, aerobic and thermophilic decomposition, controlled and managed, of degradation of organic waste, which results in a more chemically and biologically stable organic product for use as an agricultural input (PIRES, FERRÃO, 2017, p.5).

It is understood that the importance of composting is mentioned in several studies since this technique has contributed to health, environmental, agricultural, and economic policies that have become effective with its processing makes possible in agricultural input.

In the view of Malheiros et al (2014), composting is of paramount importance, even referring to the generation of waste, households with food and others that are discarded, which is demonstrated by other studies its reuse as a collection of organic waste that can be recycled.

Thus, it is understood by the study that:

> Composting is a technique to obtain the stabilization of organic matter in a shorter time and under better conditions. [...] They add that the composting process, in addition to reducing the volume and concentrating the nutrients, provides as a final product a material that can be used to improve the physical and chemical conditions of the soils. (WOJAHN, 2016, p.28).

In short, composting as a technique has helped in the best ways of organic matter, making it possible to discard, reuse and recycle in reducing the volume that affects the environment, and that can offer physical and chemical risks to the soil and human health itself.

Studies by Rodrigues et al (2015) point out that composting, in addition to helping in the processing of organic matter, when well used, has resulting advantages over the stable product or similar to humus.

In this sense, Malheiros et al (2014, p.2):

> Composting provides a useful destination for organic waste, preventing its accumulation in landfills and dumps. This process allows for a destination for agricultural, industrial and domestic organic waste, such as food scraps and garden maintenance/pruning waste. The material used has as a final result a product called organic compost, which can be applied to the soil to improve its characteristics without causing risks to the environment.

Therefore, the relevance of composting was found in the evidence of studies in the literature with cataloged data on organic waste that is recycled with technological resources safely and reliably, since this process reduces agricultural impacts contributing to other factors linked to this condition.

COMPOSTING IN BRAZIL

As already outlined in the study, the definition and applicability of composting is one of the debates that has been gaining prominence in the agricultural scenario, since it enables the recycling of organic materials, whether residential, industrial, chemical and physical, as well as their initial processing, already bringing the result and contribution without causing damage and environmental impacts.

According to Malheiros et al (2014), composting, in addition to being a simple and low-cost technique, promotes the influence of action factors that affect microbiological activity on the results with the "final quality of the compounds, such as humidity, oxygenation, temperature, particle size of the material, nutrient concentration and C/N ratio." (MALHEIROS et al., 2014, p.3).

"In Brazil, however, this type of recycling occurs in only 4% of the organic fraction generated, and more than 60% of the total mass of waste generated by the population is classified as organic waste." (PIRES and FERRÃO, 2017, p.1).

It is mainly understood that the vigor of composting, as it is a very old technique, is mainly understood its real importance in the current scenario, thus aiming that organic waste has a disposal, recycling that is not consequences for the human being, in health, in industrial areas as well as in the scope of nature.

It is the alternative that best fits the question of solid waste recycling and always valuing sustainability, an impactful and necessary subject nowadays, because of the news that surrounds it. Thinking about the best use of its benefits, the factors that are interconnected to composting are fundamental to the final result so that it is timely (WOJAHN, 2016).

One of the factors that concern waste in Brazil is linked to "The environmentally appropriate disposal of organic waste is its disposal in landfills,[4] or its recycling through composting, this destination being a priority." (PIRES and FERRÃO, 2017, p.3).

In other words, the landfill is one of the places that are the responsibility of municipal bodies, and due to the high rate of contamination, which can favor types of diseases, infections, these wastes must be separated from the so-called hospital waste, however, the landfill ends up generating impacts on the environment, because over time as Pires, Ferrão (2017) explains that with exposure to the outdoors and due to the climatic type, These residues release gases and may reside in the contribution of chemical and physical pollution, since thousands of microorganisms become stronger and become vulnerable due to climate exposure.

However, composting in Brazil can be explained as follows:

> As for the generation of waste in the country, more than half is organic (of animal or vegetable origin, for example, food remains, tree leaves, bird viscera, among others) and of this amount only 4% is recycled by composting plants, most of which are located in the south and southeast regions. From this equivalent, it is possible to infer that of the 62 million tons of waste generated by Brazilians in 2011, approximately 37 million tons corresponded to organic waste and that only 1.5 million tons were recycled. In addition, the selective collection practiced in Brazil does not emphasize the prior separation of the organic fraction from the waste. This is because the composting of this waste is the alternative that allows the greatest environmental benefits, as it enables the cycling of nutrients, can improve the physical, chemical and biological conditions of the soil and

[4] The sanitary landfill, unlike dumps and controlled landfills, must be built according to defined techniques, such as soil waterproofing so that the leachate does not contaminate the water table, the leachate drainage system and the drainage of gases, especially carbon dioxide, methane gas and hydrogen sulfide gas in order for the land not to be subject to explosions and landslides (CETESB, 2016).

> implies in the reduction of the need to explore sources of raw material for the production of organic fertilizers (PIRES, FERRÃO, 2017, p.3).

It is through them that you have a basis for the preparation of the compost, handling it in the way that best suits the levels considered ideal.

Given this, explanations by Malheiros et al. (2014) point out that waste of all types is worrisome, since environmental policies for companies maintain as a basic rule, the disposal of waste safely, in reliable places that cannot affect people, the environment and especially health in general.

The use of industrial, residential, chemical and physical waste is a relevant factor, both for the environment and for the enterprises that sell this waste, because the environmental liabilities originated are of marked hardness, due to the abundance and certain substances present.

In this sense, the market panorama with so many modifications and with the technological innovations that man seeks to give greater maintenance to his ideas, exhibited in recent years the great concern with what is left of unused and discarded materials, because the reflections point out that it is not only to produce material goods, but to safeguard the environment with an environmental policy under the guidelines and legislation in force (SILVA, 2012).

Since the most remote time of prehistory, man has been able to carry out various activities in the search for his survival, going through great changes, and this in a way has been generating problems and impacts on nature and political, economic and social issues around the world.

According to Silva (2007, p. 14), it is understood that:

> When these deposits become too bulky, they become, by themselves, unstable and subject to localized landslides. During the rainy season, they must be removed and transported continuously to the lower regions and, in many cases, to watercourses. The continuous repetition of the process causes the considerable transport of this material, gradually causing the silting of watercourses. In addition to the volume from the sterile material, the quantities from the area of the deposits themselves and the material produced by the decomposition of rocks and soil erosion must be considered.

The great concern with waste is linked to the environment, which is moving slowly in Brazil, unlike developed countries, which receives special priority. The deficiencies in so many areas prevent the addition of technologies/investments in the environmental area, thus delayed, we continue to pollute.

Therefore, the use of this waste of organic materials needs both management and strategies that are safety measures adopted by companies thus following environmental legislation, in which it has been one of the great concerns with sustainability, to environmental problems caused by waste remains that can pollute water, land and air, in response (PIRES and FERRÃO, 2017).

Composting in Brazil with the agricultural scenario, as it is an area with proposals and feasibility, needs to be adapted, mainly because the environment is the main part of the company's business and must have the same importance as other commercial objectives (WOJAHN, 2016).

In this sense, it is important to discuss that it is:

> Therefore, in general, it is observed that the composting of organic waste is attractive, as the disadvantages associated with it can be worked on and remedied through segregation, packaging and correct management of this waste for the efficient performance of the composting operational process. Currently, Brazil has 260 composting plants which are responsible for composting 4% of the organic waste generated in the country in the Brazilian territory, it can be seen the heterogeneity with which it occurs, since 90% of the total amount of existing composting plants are concentrated in the south and southeast regions. This inequality follows the same trend found by the HDI (Human Development Index, which is based on indicators related to health, education, and income) for the Brazilian federation units, which found that the worst indices were located in the north and northeast regions (PIRES, FERRÃO, 2017, p.7).

This reflection can be observed in the table described in this study, figure 1.

Figure 1 – Brazilian regions with urban cleaning and/or garbage collection services, by units of final disposal of the garbage collected – 2000.

Region	Open-air dump (landfill)	Leakage in flooded areas	Controlled Landfill	Landfill	Special Waste Landfill	Composting Plant	Recycling Plant	Incineration
North	848	8	44	32	10	1	-	4
North East	2,538	7	169	134	69	19	28	7
Midwest	406	1	132	125	29	6	19	3
Southeast	1,713	36	785	683	483	117	198	210
South	848	11	738	478	219	117	351	101
Brazil	5,993	63	1,868	1,452	810	260	596	325

Source: Brazilian Institute of Geography and Statistics, 2000.

In terms of literature considerations, composting in Brazil has undergone changes in its policies and guidelines in which it cannot be restricted to its processing, but to management, to the type of logistics with transport, security, packaging, recycling, and the main thing, its disposal in a safe and reliable environment.

Therefore, the correct thing in composting needs the direct contribution of environmental management and is due to the treatment and disposal of hazardous organic waste that may impact the environment and the health of individuals, that is, they become an important guideline about the environmental responsibility of a company, and the proposal interconnected to techniques as to methods strategies on waste management must be maintained, with the commitment to raise awareness in the internal community, and outline parameters for definitions of safe routines, reflecting on minimizing the consequence of an accident with transport, ways to pack this waste with products so as not to incur risks.

FACTORS THAT INTERFERE WITH COMPOSTING

The factors that are related to composting and interfere in some way are microorganisms, aeration, humidity, temperature, C/N ratio, pH, granulometry and the size of the windrows. For the correct performance of composting, it is strictly necessary to pay attention to these factors, because in some way or another they influence the final result of what will be obtained.

Reflecting on the best use of its benefits, the factors that are interconnected to composting are fundamental to the final result so that they are in the ideal parameters.

MICROORGANISMS

The modification of organic matter is a consequence of the combined action of macrofauna and mesofauna (earthworms, ants, beetles and mites) and different microorganisms (bacteria, yeasts, actinomycetes) present in different stages of composting (OLIVEIRA et al., 2008).

The composting process is signaled by an uninterrupted change in the species of microorganisms involved, due to the modifications that occur with the conditions of the environment, in which it would be very unlikely to notice all those present (MILLER, 1992).

According to Silva et al. (2003), it is possible to find a wide diversity of mesophilic and thermophilic aerobic microorganisms involved in the composting process, and these are usually detected in organic remains, encompassed by the groups of bacteria, actinomycetes, yeasts and fungi. The use of beneficial microorganisms in the formation of composting can yield a higher concentration of nutrients and lack of odor to the final compost, which makes the process satisfactory and accelerated (VICENTINI et al., 2009).

Microorganisms perform the decomposition of organic matter, retain carbon and nitrogen, and the time is sufficient for decomposition and mineralization to occur, headed by the relationship of the two nutrients, carbon and nitrogen, of the raw material (KIEHL, 1985). Smith and Paul (1990) point out that understanding microbial processes is important for the knowledge of nutrient cycling and organic matter dynamics.

In the work carried out by Vicentini et al. (2009), through experiments with efficient microorganisms (EM) and without these efficient microorganisms, it was shown that with the addition of these microorganisms in the treatment at the time of preparing the compost pile, it was possible to reduce the preparation time of the compost and even cooperate for the reproduction of earthworms.

AERATION

It is the most important factor for the process of decomposition of organic matter (PEIXOTO, 1988). In the exercise of composting, it is also the most substantial, of which the wetter the raw materials are, the more imperfections in oxygenation, indicating that measures should be taken to reduce humidity (OLIVEIRA et al., 2008).

It consists of an aerobic or anaerobic form of achievement. If considering a large quantity, aeration is essential and its purpose is to provide the oxygen demand of microorganisms and operate in the control of temperature and odors. It can manifest itself naturally, through overturning or mechanically, which would be by air injection (DAZZI et al., 2018).

The contribution measured by oxygen improves the state of the process, preventing bad odors, approximation of vectors and leads to faster oxidation of organic matter (MASSUKADO, 2008).

In the execution of the aerobic form, it concerns the decomposition of organic substrates with the appearance of oxygen, in which the main products obtained from biological metabolism are $CO2$, $H2O$ and energy. The adverse form is anaerobic, that is, the one that is free of oxygen, resulting in the production of $CH4$ and $CO2$. In addition, intermediate products are included, such as organic acids of low molecular weight (KIEHL, 2004).

In general, it is feasible for aeration to be aerobic, since microorganisms need oxygen for their metabolism. The conservation of oxygen at appropriate levels inside the cell also has the function of extracting the abundance of heat produced, water vapor and random gases produced by the degradation of organic matter. The lack of oxygen inside the cell induces the process to be anaerobic, which regularly leads to acidification of the material, and the finished product will be of poor quality. Aeration also facilitates temperature preservation, preventing odors and the proliferation of flies, in addition to reducing composting time, in contrast to anaerobic aeration, which is up to ten times longer (HERBETS and MILETTI, 2005).

Richard et al. (2002) state that from 10% or more the oxygen concentrations are within the optimal standard for maintaining composting under aerobic conditions.

However, aeration has to be very well monitored, as an excessive air supply can lead to more intense heat loss than microbial heat production (LAU et al., 1992).

Azevedo (1997) recorded the optimal requirement for oxygen in a compost pile. The annotated panorama says that the concentration should be between 5 and 15% of oxygen, considering an ideal parameter, where 5% is already included as a minimum limit so that it does not become an anaerobic process.

HUMIDITY

Water is essential for microorganisms for their metabolic activities to be carried out. Humidity should predispose to the transport of nutrients, without adulterating gas exchange and aerobic conditions (VIEIRA, 2016). The humidity range considered perfect, with the peak of decomposition mainly in the initial period, is between 40 and 60%, because it is feasible to have a water supply to provide the growth of biological organisms and the biochemical reactions to occur in the most correct way (MERCKEL, 1981).

Reis et al. (2004) reaffirm the thesis put forward by Merckel, adding that values below 40% restrict the agility of degradation, since the amount of water needed by microbial activities is not supplied.

Another point exposed by him is that values above 60% grant the development of anaerobic conditions, formation of leachate and bad odor, in addition to nutrient losses. For Rodrigues et al. (2006), they cite the ideal perfect parameter with an even smaller difference, with values between 50 and 60%.

The abundance of moisture decreases the penetration of oxygen into the windrow, since the decomposed organic matter is hydrophilic and the water molecules join vigorously to the surface of the particles, saturating their micropores and macropores (ECOCHEM, 2004).

Humidity indirectly interferes with the temperature of the composting process, which is an inference of the metabolic activity of microorganisms, occurring in the aqueous phase (VALENTE et al., 2009).

According to Margesin et al. (2006), they studied the biological activity during the composting of sewage sludge and found that the decrease in moisture content hindered the metabolic activity of the microorganisms, directly affecting the temperature.

The ideal humidity should be managed on top of the ideal capacity for aeration of the compost mass, that is, physical characteristics such as the porosity and structure of the material should be examined, always seeking to meet the microbiological demand for oxygen (PEREIRA NETO, 1998).

Therefore, humidity has, together with the other related factors, a direct effect on the development of microorganisms and an indirect effect on the temperature of the composting process, and the one considered excellent changes with the material to be composted and with the cellulosic material used (VALENTE et al., 2009).

According to Peixoto (1988), the effectiveness of composting is linked to the interdependence and interrelationship of these factors.

TEMPERATURE

Temperature is a part that influences both the specific nature of microorganisms and the time of decomposition (KUMAR et al., 2009).

The average amount that is worked with it is 55ºC. The most present microorganisms are aerobic and facultative, those that are concentrated between temperatures of 20 and 45ºC, the mesophilic, and those from 45 to 65ºC, the thermophiles. These previously mentioned release energy in the form of heat, further raising the temperature of the compost (DAZZI, 2018).

According to Da Silva (2007), thermal control is relevant, since it is used to ascertain the stage of the process. Another point to be highlighted in this statement is that said by the authors Gajalakshmi and Abbasi (2008), that it is a considerable factor inherent to the elimination of pathogenic microorganisms.

According to Kiehl (1998), in the composting process, the microbiological activity reaches high intensity, with an increase in the temperature inside the windrows, with values that aim for 65ºC or even values well above, due to the generation of heat by the microbiological metabolism of oxidation of organic matter, which is exothermic.

For a better understanding of how temperature works according to possible alternations, Trautmann and Olynciw (2005) listed four significant phases.

1st – Mesophilic phase: it is considered to be the one that predominates moderate temperatures, up to close to 40ºC. It lasts an average of two to five days.

2nd – Thermophilic phase: when the material approaches its maximum temperature

(> 40ºC) and deteriorates faster. It does not have an accuracy in its duration, as it can be several days to several months, according to the attributes of what is being composed.
3rd – Cooling phase: it is signaled by the drop in temperature to ambient temperature values.
4th – Maturation phase: it is the consolidation period that produces a matured, highly stable and humified compost, free of toxicity.

To verify these phases, it is enough to penetrate an iron bar (rebar) to the bottom of the piles, during the composting process. The bars must be removed to determine the temperature every two or three days until the first turnover, changing to once a week until the end of the process (DAZZI, 2018).

The temperature check must be carried out by palpating with the palm of the hand the part of the iron bar that was inserted in the materials being composted, which can happen in three ways: the first the iron bar is heated, but with tolerable contact, showing that the process occurs naturally. The second is that the iron bar is too heated to the point of impossibility to touch, intolerable, where in this case the temperature is too high and the material must be turned over if it is too wet, or moistened in the dry situation. The third is that the iron bar is warm or cold, and then the time of occurrence of the process must be considered, that is, if the first turning has not yet been done, it is possible that the pile is lacking moisture or it has not been designed with the correct dimensions. If the process has been underway for more than seven weeks, with two or more turnovers, the low temperature indicates that the decomposition is solid, so the compost is finished (OLIVEIRA et al., 2008).

The finished compost, in addition to the fact that it has a temperature identical to the environment, manifests itself brittle when dry, moldable when wet, does not attract flies and does not have an obnoxious smell (OLIVEIRA et al., 2008).

In this sense, some of the factors here directed to composting, the use of either by recycling or different types of organic materials from waste should be treated as one of the relevant factors, both for the environment and for the enterprises that sell this waste, because the environmental liabilities originated are of marked harshness, due to the abundance and certain substances of microorganisms present.

C/N RATIO

To carry out composting, it is necessary to have the participation of some macronutrients and micronutrients, so that metabolic activities can take place. The most prominent are carbon and nitrogen, carbon being a source of energy and the basic structural unit of organic molecules that stimulate microbial growth and nitrogen vital in protein synthesis such as proteins, nucleic acids, amino acids, enzymes and coenzymes (BATISTA and BATISTA, 2007). The C/N ratio is a list used to evaluate the levels of maturation of organic substances and their results on microbiological growth, because the activity of heterotrophic microorganisms, covered in the process, depends on both the carbon content for energy source and nitrogen content for protein synthesis (SHARMA et al., 1997). The effectiveness of a composting process is directly proportional to the effectiveness with which microorganisms are able to acquire and metabolize nutrients (HERBETS and MILETTI, 2005).

According to Silva et al. (2003), microorganisms preferentially need carbon (it is given as a source of energy for metabolic oxidation) and nitrogen (useful in the synthesis of amino acids, proteins, enzymes) to then grow. Chemical analyses have established that microorganisms contain, on average, 50% carbon, 5% nitrogen and 1% phosphorus (AZEVEDO, 1997). When this ratio is in aerobic conditions, a piece of carbon is released in CO2 and what is left is used with nitrogen during the microbial process, and for this gas the thermophilic phase is the most accentuated in relation to composting (BATISTA and BATISTA, 2007).

Throughout the process, the carbon consumption carried out by microorganisms is 15 to 30 times more compared to nitrogen (KIEHL, 2004). Its beginning occurs in the 30:1 ratio, exhausting over time, and can end between 10:1 and 15:1 (KUMAR et al., 2009). The C/N ratio derives from the dosage of the materials incorporated into the composters. Usually, straw residues, such as dried vegetables, are a source of carbon, while excrement, legumes and dried fruits are more nitrogen-enriched. Materials with a high C/N ratio, based on wood, give structure to the volume of waste and are regularly used. Ratios lower than 30/1 have a nitrogen surplus. Thus, there is a need for materials that contain carbon to balance the process (INÁCIO and MILLER, 2009).

The ratios that can occur, according to Kiehl (2004), are as follows: below 10:1 it can indicate nitrogen loss by volatilization in the form of NH3 and odor beginning. Between 25:1 and 30:1 are the indications of the most perfect possible, best condition. Between 30:1 and 50:1 means it can be more accelerated. Above 50:1 causes nitrogen deficiency and extended maturation time.

pH

The elementary materials of organic origin, used as raw material in composting, are naturally of acid origin. Thus, commonly, a windrow with organic matter has a primordial acid reaction (VALENTE et al., 2009). pH is a significant parameter, as it is what conditions the evolution of microorganisms. However, it is not a limiting factor to the positive outcome of the process, as far as it can be seen, microorganisms can evolve in different pH ranges (HERBETS and MILETTI, 2005).

It is from it that information is extracted which indicates the state of decomposition of the compound, where the final result must be alkaline (COSTA, 2005). Values that are too high or low can impair microbial activity, making decomposition unfeasible or halting (ANDREOLI, 2002). The pH range judged as optimal for the development of the microorganisms in charge of composting is between 5.5 and 8.5, since most of the enzymes are active in composting (RODRIGUES et al., 2006). However, for the development of fungi, the adequate pH is 5.0 (SILVA et al., 2003).

The pH of organic waste at the beginning of the process is usually in the range of 5.0 to 6.0, and in the first few days it is possible to drop slightly due to the production of organic acids. However, in a few days, due to the decomposition of soluble proteins, the pH becomes in the neutral to mildly basic range, which goes from 7.0 to 8.5 (BAETA-HALL et al., 2003). However, the primary pH of the pile must be checked before starting the composting process, because very high values (exceeding 8.0) can lead to the loss of nitrogen due to the formation of ammonia. The progress of the process anaerobically can be perceived by reading the pH, which should generally be in the range of 4 to 5 (AZEVEDO, 1997).

Low pH values are indications that there is a lack of ripeness as a result of the short duration of the process or the occurrence of anaerobic processes inside the compost pile. As fungi and bacteria digest organic matter, acids are released that accumulate and acidify the environment. This drop in pH stimulates the growth of fungi and the decomposition of cellulose and lignin. Later these acids are deteriorated until complete oxidation. However, if there is a shortage of oxygen, the pH may contain values even lower than 4.5 and limit microbial activity, thus delaying the composting process. In these situations, it is recommended to stir so that the pH resumes the rise (OLIVEIRA et al., 2008).

GRAIN SIZE

Granulometry is the factor that sustains aeration and limits oxidation time, intervening directly in aeration (DAZZI, 2018). As a result, Da Silva (2007) implies that larger particles are those that grant excellent aeration, while smaller or very fine particles are the opposite case, making it difficult. Rodrigues et al. (2006) argue that elements with very fine graining originate few porous spaces, intricate the diffusion of oxygen inside the windrow, thus prevailing the emergence of anaerobic conditions. These conditions, Kiehl (2004) states that they occur due to the presence of a greater amount of micropores, resulting in compaction and increased density of the composted substrate. The size of the particles also has an enormous influence on the composting period, taking into account that the more fragmented the material destined for the compost, the faster the decomposition, because the greater the contact surface (interaction) between microorganisms and nutrients (TEIXEIRA et al., 2002).

However, the material does not have to be smaller than an established limit, as compaction of the pile and the appearance of anaerobic points may occur. In the case of composting urban waste, the ideal size in the range of 20 to 50 mm is suggested (HERBETS and MILETTI, 2005). According to Silva et al. (2003), they propose a different conception, from 25 to 70 mm.

In a test carried out by Hamoda et al. (1998) they tested 5 particle sizes, these in the values of 5, 10, 20, 30 and 40 mm, where they evaluated the effect of each one in the process. They were separated into two groups, A and B, with the first three sizes (5, 10 and 20) and the last three (20, 30 and 40) in the second. In what contained smaller particles, the pile that was made with 5 mm material was the one that manifested the highest speed of decomposition of total organic carbon. On the other hand, particles with larger dimensions in millimeters reached the highest decomposition speed. In carrying out this test, he came to the conclusion that the particle's stature should not be too small due to the compaction of the pile and not too large, as it would further extend the time of the process.

SIZE OF WINDROWS

A composting windrow is recommended to be large enough to interrupt the dizzying dissipation of heat and humidity and, simultaneously, allow good air circulation (RODRIGUES et al., 2006). The height of the material for windrow sizing should be between 1.5 m and 1.8 m (KIEHL, 2004). However, Nunes (2003) found that in windrows with dimensions of 2.60 m in length, 2.00 m in width and 1.00 m in height, temperatures were between 40ºC and 55ºC for an extended period, with average elevations of 10ºC being recorded, promptly after the incorporation of manure into the wood shavings and sawdust substrates.

Costa et al. (2006), in an experiment to evaluate the composting of poultry carcasses in cells with and without aeration, in which these cells were completed up to 1.80 m in height, observed that the temperatures remained between 40ºC and 70ºC for the two systems evaluated. On the other hand, Valente (2008) evaluated the composting of

carcasses of female broiler chickens and prime cuts of female broiler chickens, operating poultry litter as cellulosic material. After the first phase of composting, windrows of 1.60 m wide, 1.00 m high and 3.00 m long were elaborated, where the turning was exercised every 18 days, in the same way as the addition of water to the mass in compost.
In his work, he measured that the temperature varied from 40ºC to 70ºC, increasing at the same instant after each turning action and decreasing thereafter, thus obtaining a decrease in the moisture content inside the windrows. Thus, due to the material to be composted, the height of the windrows must be defined. However, a minimum height of 0.80 m must be followed, where below it there are no compatible conditions for the formation and conservation of temperature (VALENTE et al., 2009).

RESULTS AND DISCUSSION

The results were addressed by the convergence of the main ideas about composting that is interconnected to organic materials, recycling of these wastes through the technique that has been effective in their processing.

In this sense, the market panorama with so many modifications and with the technological innovations that man seeks to give greater maintenance to his ideas, exhibited in recent years the great concern of waste and as composting is a low-cost technique, has stood out in the agricultural environment to minimize risks and promote the recycling of organic materials.

In view of this, the importance was divided to carry out composting, it is necessary the participation of some macronutrients and micronutrients, and in this way it is then possible to carry out metabolic activities. The most prominent are carbon and nitrogen, carbon being a source of energy and the basic structural unit of organic molecules that stimulate microbial growth and nitrogen vital in protein synthesis such as proteins, nucleic acids, amino acids, enzymes and coenzymes (BATISTA and BATISTA, 2007).

The C/N ratio is a list used to evaluate the levels of maturation of organic substances and their results on microbiological growth, because the activity of heterotrophic microorganisms, covered in the process, depends on both the carbon content for energy source and nitrogen content for protein synthesis (SHARMA et al., 1997).

The effectiveness of a composting process is directly proportional to the effectiveness with which microorganisms are able to acquire and metabolize nutrients (HERBETS and MILETTI, 2005).

According to Silva et al. (2003), microorganisms preferentially need carbon (it is given as a source of energy for metabolic oxidation) and nitrogen (useful in the synthesis of amino acids, proteins, enzymes) to then grow. Chemical analyses have established that microorganisms contain, on average, 50% carbon, 5% nitrogen and 1% phosphorus (AZEVEDO, 1997).

When this ratio is in aerobic conditions, a piece of carbon is released in CO2 and what is left is used with nitrogen during the microbial process, and for this gas the thermophilic phase is the most accentuated in relation to composting (BATISTA and BATISTA, 2007).

Throughout the process, the carbon consumption carried out by microorganisms is 15 to 30 times more compared to nitrogen (KIEHL, 2004). Its beginning occurs in the 30:1 ratio, exhausting over time, and can end between 10:1 and 15:1 (KUMAR et al., 2009).

The C/N ratio derives from the dosage of the materials incorporated into the composters. Usually, straw residues, such as dried vegetables, are a source of carbon, while excrement, legumes and dried fruits are more nitrogen-enriched. Materials with a high C/N ratio, based on wood, give structure to the volume of waste and are regularly used. Ratios lower than 30/1 have a nitrogen surplus. Thus, there is a need for materials that contain carbon to balance the process (INÁCIO and MILLER, 2009).

The ratios that can occur, according to Kiehl (2004), are as follows: below 10:1 it can indicate nitrogen loss by volatilization in the form of NH3 and odor beginning. Between 25:1 and 30:1 are the indications of the most perfect possible, best condition. Between 30:1 and 50:1 means it can be more accelerated. Above 50:1 causes nitrogen deficiency and extended maturation time.

However, in the approach, another important result is mentioned that elementary materials of organic origin, used as raw material in composting, are naturally of acid origin. Thus, commonly, a windrow with organic matter has a primordial acid reaction (VALENTE et al., 2009).

In this sense, in the literature, the influence of pH is a significant parameter, as it is what conditions the evolution of microorganisms. However, it is not a limiting factor to the positive outcome of the process, as far as it can be seen, microorganisms can evolve in different pH ranges (HERBETS and MILETTI, 2005). It is from it that information is extracted which indicates the state of decomposition of the compound, where the final result must be alkaline (COSTA, 2005). Values that are too high or low can impair microbial activity, making decomposition unfeasible or halting (ANDREOLI, 2002).

The pH range judged as optimal for the development of the microorganisms in charge of composting is between 5.5 and 8.5, since most of the enzymes are active in composting (RODRIGUES et al., 2006).

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Low pH values are indications that there is a lack of ripeness as a result of the short duration of the process or the occurrence of anaerobic processes inside the compost pile. As fungi and bacteria digest organic matter, acids are released that accumulate and acidify the environment. This drop in pH stimulates the growth of fungi and the decomposition of cellulose and lignin. Later these acids are deteriorated until complete oxidation.

However, if there is a shortage of oxygen, the pH may contain values even lower than 4.5 and limit microbial activity, thus delaying the composting process. In these situations, it is recommended to stir so that the pH resumes the rise (OLIVEIRA et al., 2008).

And thus, on these reflections, the development of results, address that granulometry is the factor that sustains aeration and limits oxidation time, intervening directly in aeration (DAZZI, 2018). As a result, Da Silva (2007) implies that larger particles are those that grant excellent aeration, while smaller or very fine particles are the opposite case, making it difficult.

Rodrigues et al. (2006) argue that elements with very fine graining originate few porous spaces, intricate the diffusion of oxygen inside the windrow, thus prevailing the emergence of anaerobic conditions. These conditions, Kiehl (2004) states that they occur due to the presence of a greater amount of micropores, resulting in compaction and increased density of the composted substrate.

The size of the particles also has an enormous influence on the composting period, taking into account that the more fragmented the material destined for the compost, the faster the decomposition, because the greater the contact surface (interaction) between microorganisms and nutrients (TEIXEIRA et al., 2002).

However, the material does not have to be smaller than an established limit, as compaction of the pile and the appearance of anaerobic points may occur. In the case of composting urban waste, the ideal size in the range of 20 to 50 mm is suggested (HERBETS and MILETTI, 2005). According to Silva et al. (2003), they propose a different conception, from 25 to 70 mm.

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And finally, to conclude, it is necessary to understand that A composting windrow is recommended to be large enough to interrupt the vertiginous dissipation of heat and humidity and, simultaneously, allow good air circulation (RODRIGUES et al., 2006). The height of the material for windrow sizing should be between 1.5 m and 1.8 m (KIEHL, 2004).

However, Nunes (2003) found that in windrows with dimensions of 2.60 m in length, 2.00 m in width and 1.00 m in height, temperatures were between 40ºC and 55ºC for an extended period, with average elevations of 10ºC being recorded, promptly after the incorporation of manure into the wood shavings and sawdust substrates.

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In his work, he measured that the temperature varied from 40ºC to 70ºC, increasing at the same instant after each turning action and decreasing thereafter, thus obtaining a decrease in the moisture content inside the windrows.

Thus, due to the material to be composted, the height of the windrows must be defined. However, a minimum height of 0.80 m must be followed, where below it there are no compatible conditions for the formation and conservation of temperature (VALENTE et al., 2009).

FINAL CONSIDERATIONS

To reach the conclusion, the articles used in this study were analyzed, in which the convergences of ideas presented showed that there must be means to ensure the storage of this waste of organic materials to be discarded or recycled.

The composting technique, because it is low cost, in congruence with important studies, even though it is still a very old technique, continues to be the best solution for the safe and reliable processing of organic material waste because of its agents, the "microorganisms".

Therefore, it is concluded that most of the authors analyzed consider that the composting of organic material waste provides safety and prevents its improper disposal from causing serious environmental, social and economic problems, thus minimizing the negative impacts. The purpose of this work was to show how important it is to be aware of the factors that act in the process until it reaches its balance, since it can become an innovative and authentic issue, in addition to encouraging good agricultural practices, reporting their advantages to those who are still unaware.

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