Composting: Advantages and Disadvantages

M. Kokhia

Institute of Zoology, Ilia State University
3/5, K. Cholokashvili Ave., 0162, Tbilisi, Georgia,
mzia.kokhia@iliauni.edu.ge

Abstract. Nowadays mankind is facing acute environmental problems. Hundreds of tons of biodegradable organic waste are being generated in cities and towns creating disposal problems. This waste can be converted into valuable compost by applying vermicomposting technology. The vermitechnology has been revived worldwide with diverse ecological objectives such as waste management, soil detoxification and regeneration and sustainable agriculture. A great attention should be paid to the production of ecologically pure food and increase of agricultural crop productivity using organic fertilizers to protect soil and crops from contamination with nitrates, phosphates and other mineral fertilizers. Promotion of vermitechnology in Georgia is essential in order to improve agricultural production quality and increase yield. Vermicomposting is widely practiced in various countries. The vermicompost may be used for farming, landscaping, for making compost tea or for selling. Some of these operations produce worms for fishing and home vermicomposting.

However above listed advantages of vermicomposting does not mean to trust blindly bioproduct producers and not to listen to the opposite opinion of other professionals.

Thus, what are the disadvantages of vermicomposting?

Risk assessment is a new relatively young, yet rapidly developing interdisciplinary scientific trend worldwide. Today we can say with confidence that application of any technique of waste management involves many risks. The risks associated with waste management are described quite well in scientific literature. To identify the risks associated with composting of various organic wastes, the dynamics of the process itself should be clearly understood.

The paper discusses advantages and disadvantages of this complex process and provides the recommendations for those who are willing to be engaged in vermicomposting.

Key words: Vermitechnology, earthworms, microorganisms, fertilizers, microscopic fungi, bioproducts.

Fertility is a significant property of an agricultural soil. Soil fertility gets affected by excessive use of chemical fertilizers. The natural fertility of the untreated soil can be achieved through the biological cycle. The saprophagous soil invertebrates are directly involved in the transformation of soil organic compounds. One of the most important functions of the soil inhabitants is their input in the soil covering formation. Long-term investigations showed that earthworms are the most numerous and active soil residents. By digging the subsoil, loosening and threading it with tunnels worms gradually deepen the topsoil layer, ripping up fine mineral particles and depositing them as castings on or near the surface of the soil. They constantly add nutrients to the zone in which plant roots feed and deliver mineral substances that would otherwise remain largely unavailable to most plants. In this process, they are indispensable. The soil is a natural habitat for many living organisms - 1m$^3$ of soil can be inhabited by 1000 organisms. Representatives of the soil macrofauna such as earthworms, centipedes, beetles and other saprophagous actively feed on plant remains mineralize them, stimulate microbial activity and thus
participate in the formation of soil. It should be noted that number of microorganisms in the earthworms' waste is greater than in organic matter which they consumed. The soil microorganisms multiply by several times in their faeces [1, 2]. As organic matter passes through their intestines, it gets fragmented and consumed with microorganisms. Increased microbial activity facilitates the cycling of nutrients from organic matter and their conversion into forms that can be readily consumed by plants. Thus, the above mentioned symbiosis of earthworms and microorganisms can be proved. Earthworms use the byproducts of the metabolism of microorganisms and create necessary conditions for friendly microorganisms in their intestine and destroy pathogens [3].

Nowadays mankind is facing acute environmental problems. Hundreds of tons of biodegradable organic waste are being generated in cities and towns in the country, creating disposal problems. This waste can be converted into valuable compost by applying vermicomposting technology. This approach reduces pollution, provides a valuable substitute for chemical fertilizers and induces less harmful impact on the environment. A great attention should be paid to the production of ecologically pure food and increase of agricultural crop productivity using organic fertilizers to protect soil and crops from contamination with nitrates, phosphates and other mineral fertilizers. Promotion of vermitechnology in Georgia is essential in order to improve agricultural production quality and increase yield.

One of the main processes of vermitechnology is vermicomposting. Vermicompost is an excellent nutrient-rich organic fertilizer and soil conditioner containing water-soluble nutrients. Vermicomposting is widely practiced in various countries, the vermicompost may be used for farming, landscaping, for creating compost tea or for selling. Some of these operations produce worms for bait and home vermicomposting [4].

We would like to draw your attention to the vermicomposting and to the vermitechnology in general, and inform the society about its importance for the ecologically pure and safe bioproduction.

Besides this information will motivate the farmers/villagers to protect environment, will enable them to start bio-humus production and use it in farming.

It’s worth mentioning that adding just 10%-20% of humus to soil (in some cases even 5% was enough) turns out to be the most effective way to increase soil fertility, basing on numerous experiments and research in different countries. Thus, the positive impact of humus on soil productivity and plant growth is beyond any doubts. Humus content in bio-humus depends on a substrate type and may attain 10-15%. It was observed that soil fertility remained unchanged during 3-4 years following bio-humus addition, plant growth increased by 30-70% depending on a plant type and a geographic location of the fields.

Besides soil cultivation, earthworms maybe used as forage for poultry breeding, natural live bait for fishing as well as in medicine.

If the current state of agriculture is taken into account the development of bio-humus and vermiculture production is undoubtedly important in Georgia [5].

Bio-humus is 5-10 times more efficient compared to traditional natural fertilizers. Bio-humus is a concentrated fertilizer that contains all necessary nutritional substances and microelements for plant growth and includes a large quantity of humus compounds. The main advantage of bio-humus in comparison with manure and vermicomposts is that humus content is 4-8 times higher. Bio-humus is an unique microbiological fertilizer in which a microorganism community - the basis of soil fertility inhabits in large quantities. According to the composition and fertility of the soil used vermicompost (3-10 t / ha) into the soil. Introduction of vermicompost into the soil should increase the volume of corn and other
yield by 30-40%, while grain, potatoes and other vegetables by almost 70%. At the same time usage of bio-humus improves a product quality, increases protein in corns, a content of glucose in fruits and a vitamin content of 15-45% in vegetables and as a result, enables to get pure products free of nitrates, chlorine and other harmful compounds. Bio-humus usage is particularly effective for very contaminated and degraded soils. Bio-humus input in soil is provided both in the process of planting locally or sowing, and also on a surface with a subsequent treatment. Bio-humus does not contain pathogenic micro flora, helminths ovum, weed seeds and heavy metals. Bio-humus consumption by plants is easy and gradually within the whole life cycle period.

Products after using the bio-humus grow ecologically safe with excellent taste and marketable agricultural produce, flowers become more colorful and flavored.

Usage of a sufficient amount of bio-humus (not less than 0.5 kg per 1m2) supports the maturation of fruits, vegetables and berries, accelerated on 2-3 weeks.

The fertility of the land determines the presence of humus than the more - the better. According to the content of humus manure is not the best type of organic fertilizer. Vermicompost is the product of the technological recycling of organic waste by worms. Worms recycle organic material - manure or compost faster and more completely than the soil microorganisms in the composting process. Absorbing together with soil a huge amount of crop residues, nematodes, bacteria, fungi, earthworms digest them, highlighting the coprolite with a large amount of humus, its own micro flora, amino acids, enzymes, vitamins and other biologically active substances that inhibit pathogenic micro flora. During this process organic matter loses its smell, disinfected, gets granular form and pleasant scent of the earth.

As vermicompost exceeds 4-8 times manure and compost in the content of humus that proves its main advantage. The main nutrients in bio-humus are compounds of humic acids and contain all the necessary macro-and micronutrients for plant. The elements necessary for plant nutrition, which contain in biohumus interact with the mineral components of soil and form complicated compounds. Thus, they are securely stored from washing; slowly dissolve in water, providing nourishing of plants for a long time.

These advantages of vermicompost do not give us the right blindly trust the producers of bioproducts and not to listen to the opposite opinion of other professionals.

And thus, what are the disadvantages of composting? Precisely in such cases we say that we have to find a middle way, or it is necessary to find a way out.

As it has been already noted, a preparation of various ecologically clean composts has acquired a widespread popularity in recent years. A new field - organic farming has emerged. Its adherents actively use compost in farms, trying to do without chemical fertilizers and pesticides. In European countries the general methods of collecting and recycling of household organic waste are introduced everywhere among the population to produce a necessary amount of composts. For this purpose, as a rule, special containers or tanks are collected centrally and the whole process is controlled. The method of composting with the help of earthworms (called vermitechnological) for vermicomposts production - a new generation of organic fertilizers became the most popular.

The interest in composting in Georgia was rising over the last few years. The idea of organic farming has inspired many people, but nevertheless, it is almost never performed professionally, and especially under the control of professionals.

It is considered that the composting is an environmentally clean process which allows, on the one hand - recycle waste and on the other hand - obtain organic fertilizer. But is it really safe, especially for people involved in this process?
The workers in the field of composting are often unaware of the hygienic composting criteria. Moreover, there may be adverse results that will facilitate the rejection of composting on the whole. Thus, it is necessary to shed the light on the risks encountered during composting.

The methodology for risk assessment is new, relatively young but rapidly developing worldwide an interdisciplinary scientific trend. Firstly, it was used in the USA from the 80s of the last century. Nowadays it is widely introduced in most developed countries and recommended by the World Health Organization (WHO) as the leading tool in determining the quantitative damage to health associated with exposure to adverse environmental factors.

Today we can say that the waste management using any technique involves many risks. These risks are described quite well by different scientists [6, 7]. To identify the risk assessment of the composting of varies of organic waste, you should clearly imagine the dynamics of the process of composting itself.

Composting is a dynamic process that occurs through the activity of the community of living organisms of different groups: microflora - bacteria, actinomycetes, fungi, yeasts, algae; microfauna – protozoa; macroflora - higher fungi and macrofauna - diplopoda, mites, springtails, worms, ants, termites, spiders, beetles.

Many kinds of bacteria (≈2 000) and at least 50 species of fungi participate in the composting process. In this process not only bacteria, fungi and actinomycetes are actively involved, but also the invertebrates play a significant role. These are the main soil habitants: ants, beetles, cutworms, fruit beetle larvae, millipedes, mites, nematodes, earthworms, earwig, woodlice, springtails, spiders, enchytraeids (white worms) and others.

Many soil animals make a major contribution to the process of composting material in terms of its physical grinding. These animals also facilitate mixing of the various components of compost. Earthworms play the main role in the final stages of the composting process and the further inclusion of organic matter in the soil in temperate climates.

Thus, composting is a complex, multi-step process. Each stage is characterized by its various consortiums of organisms [8].

It becomes apparent that the more important place in the list of occupational hazards in composting process takes the pathogenic, allergenic and microbial toxins. The sources of these hazards are common pathogens of fecal origin (bacteria, viruses, cysts and eggs of intestinal parasites). The second danger is associated with the development of meso-and thermophilic fungi and actinomycetes, which play an important role in the degradation of waste. Among these microorganisms’ infectious pathogens, allergic diseases are detected.

Most organic wastes contain pathogens. However, a compostable material is not a natural habitat for pathogens, and they gradually eliminate in compost as a result of high temperatures, a competition for energetic sources and products of microbial metabolism. It’s known that anthrax have ability to survive in the soil for 100 years. According to Knoll K.H. [9] at a humidity of 40-60% and the aerobic decomposition the anthrax bacillus died in compost after 17 days. During vermicomposting most human pathogens are killed by the action of digestive enzymes of worms and by soil microorganisms.17 years ago in the United States by the conducted experiments was shown that the worms can reduce the population of pathogenic microorganisms just in 144 hours, and the achievement of normal rates for the concentration of faecal coliforms occurred in 24 hours (98.7%), Salmonella - in 72 hours (99.9%), and enterovirus - 72 hours (98.82%), and helminth eggs - in 144 hours (98.87%) [10].

Epidemiological and experimental studies have shown that pathogenic mold can be developed potentially during the production of compost. This leads to very adverse consequences, especially for
people involved in the production. A clear link of an atypical development of allergic rhinitis, conjunctivitis and asthma in contact with the spores of fungi was detected. The dark-colored species of fungi, which are the main “suppliers” of spores into the environment, can be found in the air or on the isolated particles of plant and animal origin in the form of so-called bioaerosol. Both in medicine and in mycology a large group of diseases emerged, caused by fungi. We are talking about potential pathogenic fungi and fungi-allergens. The first group includes fungi that can cause human mycoses, but at the same time can be developed and preserved in the environment. These are primarily soil-fungi. The human immune system in normal state copes with harmful mold spores that enter the body through the respiratory, digestive or reproductive systems. But these so-called immunodeficiency opportunistic pathogenic fungi become a serious pathogenic factor.

Despite the ubiquity of one of the field of composting - vermicomposting very little is known about the health risks associated with the growth of fungi in the vermicompost. It was found that the community of microscopic fungi in vermicompost differs in some respects from similar communities in conventional compost, namely diversity, species composition and abundance. Conventional compost has a high species diversity of microscopic fungi. These differences are clearly observed in the latter stages of the composting process. Impoverishment of species composition was associated with a decrease in the number of rare species of microscopic fungi. It should be noted that the number and frequency of appearance of some medically important fungi were generally higher in vermicompost than in conventional composts. This trend was observed for the genera Aspergillus. The most semination of environment is marked for vermicompost of bird droppings.

Attention should be paid to a high probability of vermicompost specific microscopic fungi community formation. The communities of vermicomposts microscopic fungi often include species of the genera Aspergillus, Fusarium, Chrysosporium that raises interests of physicians. The presence of problematic molds should be a subject of the vermicomposts mycological control during the active phase of composting in the obtained compost and in the environment.

Therefore, composting on a commercial scale should be a subject of inspection services of safety measures because of aerosols containing allergenic, pathogenic microorganisms and toxins. Industrial composting should be a controlled process leading to the optimum cleaning, i.e., elimination of allergens and pathogens, and the degradation of organic waste.

**Recommendation**

1. Nowadays precise doses of allergenic, pathogens and toxins have not been defined, that have harmful effects on human health. To determine the influence of excessive concentrations of allergens and pathogens in workers’ health involved in composting, it is necessary to carry on additional long-term epidemiological studies of the composting.

2. More and more citizens are engaged in waste composting on a small scale. Taking into consideration that these systems are conducted by an extensive method, hygienic handling of composts with high temperatures cannot always be guaranteed. A hygienic control of such systems is required.

3. Composting is a complicated complex biological process. A further research is needed to control effectively the parameters (aeration, tedding and others), which play an important role in the optimal degradation of waste, cleaning and maturation of compost.

4. A union of research institutes, enterprises and agencies involved in composting should lead to the establishment of “a good practice of composting”. The information about possible occupational hazards
for workers employed in composting should be available not only for health professionals but also for those who work with organic waste.

5. When working with compost a good personal hygiene should be observed: work in overalls, gloves (cotton, rubber). All works on the processing and packaging of composts should be performed in special clothes, using a respirator. Washing of overhauls should be carried out when it gets dirty.

6. People engaged in the production of compost should observe a good personal hygiene and mandatory undergo periodic medical examinations. All production facilities and workplaces should possess a first aid kit.

7. All specially developed requirements and precautions should be followed while storing or transporting the composts.

To develop specific recommendations for waste management and compost, to control their hygiene and agronomic properties, it is necessary to provide further joint researches of microbiologists, allergists, epidemiologists and specialists in the field of composting.

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კომპოსტირება: დადებითი და უარყოფითი მხარეები

ძ. რობი

კომპოსტირება: დადებითი და უარყოფითი მხარეები

ნაშრომში განხილულია კომპოსტირების, კიდევ კი ვერმიკულტივირების დადებითი და უარყოფითი მხარეები.

მიუხედავად იმისა, რომ კომპოსტირება ეკოლოგიურად არ არის სუფთა პროცესი, რომელიც ერთის მხრივ არაფერი უტილიზაციის, მეორეს მხრივ, კი ორგანული სასუქის მიღების საშუალებას იძლევა. ნარჩენების მართვის ნებისმიერი ტექნოლოგია, ნარჩენების გადამუშავების პროცესით იქვეა რისკები. სწორედ ამ რისკების მიხედვით ამს ქვეყანაში განვითარდეს ჰიგიენური და აგროლოგიური სერიოზული კონტროლი ნარჩენების მართვასა და კომპოსტირებაზე, მიკრობიოლოგთა, ალერგოლოგთა და ეპიდემიოლოგთა თანამშრომლობის შედეგად უნდა შემუშავდეს მეთოდოლოგიური სახელმძღვანელო კომპოსტირებაზე მომუშავე პერსონალის თანაემორჩილობა.

რეკომენდაციები

1. დღეისთავის განკარგულების მქონე ქვეყნების ჰერთენ ელექტრო, პათოგენურ მიკროორგანიზმებისა და ტოქსინების შეფასება დამახმრებლად უნდა გახდეს თუ არა ეს არსებობს. კომპოსტირებაში მომუშავე პერსონალი უნდა ჰქონდეს აგროლოგიური და პათოგენური მიკროორგანიზმების გადაწერულებით კონტროლირებული ფერადობის შეფასების
შესწავლისათვის აუცილებელია სამრეწველო მასშტაბებში კომპოსტირების პროცესის დამარცხებით სახისხელო პათოლოგიური და ჰიგიენური უსაფრთხოებები; 2. ყოველდღიურად საუკუნე ეწვი ბალახში ადამიანთან თეთრმულებისა და ჯერჯერობას კომპოსტირების ხანგრძლივი ეპიდემიოლოგიური კვლევით უზარმაზარად მოდერნული მანქანები გამოყენებით გააჩნია. უმეობა ყოველგზით იწყებს განვითარებას მცირე მასშტაბებში. ამიტომ, პროცესის განვითარება მოდერნულ მანქანებით უკვე უფრო მაღალ ტემპერატურაზე გადადგებული იქნება და აკავშირებული ჩანთები მიმდინარეობს ჰიგიენური ნიშნულით;
3. კომპოსტები - რთული კომპლექსური ბიოლოგიური პროცესი, რომელიც ნარჩენების მატარებლის გამოყენება უმეობა რეჟიმზე და ლეგენტურად დამუშავება, უფრო შესწავლილი პარამეტრები (ავადმყოფი, ლოდანმასშტაბის და ს.შ.) დამუშავება, ეფექტური ეპიდემიოლოგიური კვლევები და პროფეშონალური ოპერაციები;
4. კომპოსტებით დაკავებული კომპანიებისა და პირების მეცნიერება თან თანამშრომლობით უნდა შემუშავდეს „კომპოსტირების პროცესი და მეთოდიკა“. იგი უფრო სწორი პროცესის შესაძლოდან უუფარი სიქრე და სარგებლობაში არ უნდა გამოიწვიოს;
5. კომპოსტებში დაქვეყნებული პირის მავნეთი სამკუთხედ სამკუთხედ და ქვეპარკურთ ჯანყოფა; ადმინისტრაციის შეგიძლია გადაფარავად უნდა მოხდეს მათთვის მასთავალად;
6. კომპოსტებით განვითარებული პროცესის სამკუთხედ უუფარი უკვე უფრო ჰიგიენური, ავადმყოფი და გარემოსქეპირებული პროცესი. კომპოსტებით მოქმედება უუფარდ კომპანია უუფართა ფირმა მოქმლად გამოყენებას სამკუთხედ ჩატარა;
7. კომპოსტებში შენახვისა და ტრანსპორტირების ხანგრძლივობა უუფართა უსფრთხოება უუფართა უსფრთხოება უუფართა უსფრთხოება.
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გარეული ხატულოსნოვი სახ. 3/5, 0162, თბილისი.
ტელ.: +995 32-291-23-35; (599)14-04-23;