Is Bio-activator from Vegetables Waste are Applicable in Composting System?

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Abstract. Composting Process is alternative organic waste management for degradation waste generation. In general, bio activator will be added to the organic waste mixture which aims to accelerate the process of maturing compost and not forgetting the quality standards of it in order to apply to the soil so that the environment will stay in a healthy condition. Various types of bio activators used in the composting process such as EM-4, Acticomp, Orgadec, and also bacteria which can be produced using various source organic matters such as vegetable waste. Vegetable waste is an excellent medium for growing microorganisms, and it can be used as bio activator in the composting process. Another advantage of using this source is that vegetable waste is cheap and easy to find because they usually thrown away and not reused. Some researchers found bacteria like *Streptococcus*, *Leuconostoc*, *Lactobacillus*, and *Pediococcus* are contained by vegetables that will create lactic acid fermentation. This bacteria has a vital role in changing various sugars in vegetable waste, especially into lactic acid, which, when compost is given to the soil, bacteria will play a role to control the pathogenic organisms. Some studies about bio activator from a vegetable waste relationship have been done related to the compost quality result from the addition of the environmental bioactivation from vegetables. In this article, there will be reviews from various research journals related to the making and application of bio activator from vegetables in the composting process and to find out whether the use of vegetable waste is suitable bio activator for composting process.

1. Introduction

The production of organic waste keeps increasing due to the increases in population and activities. Organic waste comes from various sources such as household waste, market waste, and restaurant waste. In Indonesia, mostly waste is dumped into a landfill, which causes many environmental problems. One way to reduce organic waste is by composting. Due to no small amount of organic waste formed, activators need to accelerate the composting process [1][2]. Various artificial and natural activators have been widely studied and used in the composting process, including bio activators derived from vegetable waste [3].
Bio activators are purified isolated microbial and have the unique ability to digest organic material containing cellulose fibres. One of its uses is to accelerate the composting process. In addition to increasing composting, excess use of bio activator is a more guaranteed product quality, and the production process is relatively simple [4]. Many vegetables waste present nearly ideal conditions for the survival and growth of many types of microorganisms. The internal tissues are nutrient-rich and many, especially vegetables, have a pH near neutrality because the first storage polymer is starch. Most microorganisms that are initially observed on whole fruit or vegetable surfaces are soil inhabitants, members of an extensive and diverse community of microbes that collectively are responsible for maintaining a dynamic ecological balance within most agricultural systems. Some microbes in vegetables that can remodel the cellulose material, including Lactobacillus brevis, Lactobacillus plantarum, Pediococcus pentosaceus, Pediococcus acidilactici and Leuconostoc fallax [5][6][7].

Microorganism content in vegetable waste bio activator will help speed up the composting process and improve the condition of the damaged soil when the compost is applied to the soil. Another advantage is that making vegetable bio activators is very easy and low cost [6][7]. Some types of activators which are often used in composting are EM4, rice bio activators, cow manure bio activators, vegetable and fruit bio activators etc.

2. Bio-activator

Bio-Activator consists of naturally occurring microorganisms attached to organic compost. It supplements and stimulates the bacteria in situ so that the waste quickly decomposes. In the process, it prevents the generation of smells [5]. Bio-activator is made from natural ingredients that do not contain harmful and toxic substances, thereby making environmentally friendly. It consists of natural microorganisms that can stimulate bacteria to accelerate the process of decomposition. The bio activator contains cellulolytic microorganisms (i.e. tiny organisms which live on cellulose). The cellulose of agricultural wastes is used as the energy source of the cellulolytic microbe in the bio activator. It means the cellulose in plant tissues is decomposed into simple carbohydrates that can quickly be taken up by plants. The bio activator, which is applied to the fresh rice straw or other waste in the field, is formulated as an inoculant. This inoculant can accelerate the composting process to one month. Once composted, the organic material helps to increase the level of soil organic matter to maintain soil fertility, while reducing the need to apply chemical fertilizers. It has the following advantages: It is highly adaptable and can be used on almost any farm the second advantages of using bio activator is that it is environmentally safe. Bio-activator form can become in a liquid, powder (bulk or water-soluble bags), tablets and capsules, pellets, and slow-release little bars [8].

Figure 1. Rice straw (left) and the organic fertilizer made from the straw with bio activator (right) [1]
3. Compost

The organic matter with a rich source is called compost. Almost anything that comes from the ground can be composted [9]. Cucumber ends, apple cores, carrot peels, cantaloupe rinds, avocado pits, grains, coffee grounds and filters, tea leaves, herbs, spices, and nut and eggshells are all acceptable ingredients. Cut flowers or plant trimmings also can be used long as they are not diseased.

Compost will be a source of plant nutrient; it improves the biological and physicochemical properties of the soil. It improves in three ways. For example, it will: (a) becomes more resistant to stresses such as drought, diseases and toxicity; (b) helps the crop in improved uptake of plant nutrients; and (c) possesses a current nutrient cycling capacity because of vigorous microbial activity. These advantages manifest themselves in reduced cropping risks, higher yields and lower outlays on inorganic fertilizers for farmers. Raw organic materials such as crop residues, animal wastes, food garbage, some municipal wastes and suitable industrial wastes, enhance their suitability for application to the soil as a fertilizing resource, after having undergone composting. [10]

4. Composting process

The process of biological decomposition of organic waste materials such as food waste, manure, leaves, grass trimmings papers into a beneficial humus substance by various microorganisms, including bacteria and fungi in the presence of oxygen and pH is called composting [10][11]. In the specialized biodegradation process, a large variety of mesophilic, thermotolerant and thermophilic aerobic microorganisms predominantly bacteria, actinomycetes, yeasts and fungi are involved [12]. The process of bio composting occurs in three-phase. (1) The mesophilic phase, (2) the thermophilic phase, which can last from a few days to several months, (3) the cooling and maturation phase, which lasts for several months. The nature of the organic matter and the efficiency of the process being composted affect the length of the composting phases depends on, which is determined by the degree of agitation and aeration. Slightly acidic condition and the mass is at its ambient temperature usually happened at the early start of composting. Microorganisms utilize soluble and easily degradable carbon sources, monosaccharides, starch and lipids in the early stage of composting. The pH decreases because organic acids are formed from these compounds during degradation. In the microorganisms next stage starts to degrade proteins, resulting in the liberation of ammonia and an increase in the pH. As the temperature increases, thermophilic microbes develop. These consist of only some kind of bacteria, e.g. Bacillus subtilis, fungi, e.g. Aspergillus fumigatus, and actinomycetes, e.g. Streptomyces spp. [13]. After the easily degradable carbon sources have been consumed, more resistant compounds such as cellulose, hemicellulose and lignin are degraded and transformed into humic acid, fulvic acid and phenolic intermediate metabolites [14].

The humified substances are divided into following groups: humin (not soluble in water at any pH), humic acids (soluble in water under alkaline conditions) and fulvic acids (soluble in water under all pH conditions) [15]. The humification of bio compost is a result of complex symbiotic, and synergetic microbial interaction finally resulted in humifying earthy fragrances to an ideal compost. Waste composting reduces the quantity of generated waste to be disposed of and subsequently minimizes air pollution arising from landfills and open dumps which are known as the significant sources of greenhouse gas [15][16]. According to Saft and Elsinga [17], anaerobic digestion of organic wastes produces methane (MH₄) and carbon dioxide (CO₂). Composting can reduce GHG emissions by reducing the quantity of virgin waste material being disposed into the landfills and by implication minimizes, anaerobic digestion and the production of MH₄ and CO₂. Similarly, Adani et al [17] observed that waste composting produces lower GHG emissions by about 82% less than waste disposal in landfills. Composting can reduce air pollution and groundwater leachates. The conversion of organic waste into stable nutrient
compost can reduce the quantities of waste for ultimate disposal in landfill and also reduce water pollution through substitution of chemical fertilizers with compost manure in urban agriculture [15]. A study of urban agriculture in Harare [15] reported the practices of chemical fertilizers in agriculture had induced groundwater pollution through eutrophication and leaching, and it was recommended that the use of compost manure as a substitute would mitigate the pollution effects. Compost manure can enhance soil remediation and stabilizes the ecosystem. also cited that compost manure can restore nutrients in soils and maintain the sustainability of ecosystems [16].

Similarly, observed that compost manure could ameliorate soils which are polluted with heavy metals or acidic substances so that organic wastes are useful in land remediation and restoration [14]. In addition, stated that the use of composting for bioremediation of contaminated soil had been used in many developed countries [17]. These views were further supported by facts of research findings in Europe by [18] which showed organic farming has a generally positive impact on the environment, and also organic farms tend to have higher soil organic matter content and lower nutrient losses such as nitrogen leaching, and emissions of nitrous oxide and ammonia per unit area. 20% to 40% of the mass of solid wastes can be reduced by composting. The quantity of waste for ultimate disposal could be reduced by composting, which could lower the operating costs [19][20].

Every day humans create waste from the rest of their life activities; in general, there are two types of waste, namely inorganic and organic. Inorganic waste is rubbish that is not made from living things, and organic waste is the opposite. In its processing, organic waste is much easier to process because it can be used as compost, bio activator. Also, although inorganic waste can also be used, it is more unsafe for the environment.

One way to process organic waste, in general, is to convert it into compost. Compost is useful for maintaining soil content to remain nutritious and can grow plants. Making compost is easy, but it takes a long time of about 60 days. The other way to process organic waste, especially vegetable waste, is by turning it into a bio activator. The making is quite easy and inexpensive. This bio activator can be used as degradation of other inorganic waste and soil fertilizers; this fact shows that besides making it easy and inexpensive, this bio activator is also environmentally friendly.

5. Conclusion
The waste vegetable can be turned into bio activator and can be applied to degrade organic waste using biological processes.

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