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Effectiveness Of Various Types Bio-Activators To Speed Up The Composting Process And Quality Of Compost Fertilizer.

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Abstract – Organic waste has become a big environmental issue in urban areas. Food waste and plant waste are part of organic waste originating from households, the campus environment, and the food industry. Where this organic waste has a high percentage of the total waste that is disposed of in the landfill. Organic waste also pollutes the environment, causing serious greenhouse gas emissions. Throwing away food waste produces methane gas, which is harmful to the environment and causes global warming. To avoid the mass production of methane gas and environmental pollution from food waste, it is very important to minimize the disposal of food waste in landfills by encouraging waste recycling such as the use of such waste as organic fertilizer in agriculture through the composting process. Therefore, it is necessary to look for a bio activator that can accelerate the composting process by producing compost quality according to SNI. This article presents a review of the use of various bio activators that can accelerate the rate of composting. The study shows that various sources of bio activators have been used in composting food waste such as fruit, vegetables, plant fiber, and agricultural waste. Further studies are needed to see a better combination of bio activators for the composting process.

Keywords – organic wastes; compost; bioactivator; fertilizers

I. INTRODUCTION

Constituent materials taken from nature or produced from agriculture, fishery, or other activities. Most of the household waste is organic waste, such as waste from the kitchen, leftover flour, vegetables, fruit peels, and leaves[1]. The lack of efforts to utilize waste has an impact on the volume of waste increasing every day and is harmful to health and spoils the view and comfort. To overcome this problem, waste management is needed. One of the organic waste management is the composting process. Composting produces a product in the form of compost which is used in agriculture.

Composting is the process of converting bio-chemical organic matter into humus (Lignoprotein) with the help of mesophilic and thermophilic organisms. The composting process seeks to link the natural forces of decomposition to convert organic waste into organic fertilizer[2]. POH also contains complete nutrients needed by plants. Compost is an organic material consisting of plant, animal, or municipal waste that has undergone a decomposition or weathering process before the material is added to the soil [3]. Composting naturally takes a long time and therefore requires the addition of a bio activator.

Bioactivator is a liquid containing microorganisms (microorganisms) that help the decomposition process of organic matter, which is to initiate the process of physical and chemical changes of organic material into products of different natures[4]. In the process of composting organic matter, bio activators are added containing microorganisms that can reduce lignin, cellulose, protein, lipids, starch, and microorganisms that can fix nitrogen. The bacteria contained in the bio activator include photosynthetic

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bacteria, lactic acid bacteria, yeast, actinomycetes, and fermented fungi[5]. Some of the bio activators that are often used are MOL (vegetable, fruit, and coconut pulp waste), EM4, orgadec, rumen, leachate, and oil palm sludge.

Several studies on the use of bioactivators for the composting process only use one or two types of bioactivators, in this article we will discuss several bioactivators and combinations used for faster composting processes and produce compost products according to standard national Indonesia (SNI).

II. RESEARCH METHODS

This article review analyzes studies of various bio activators for composting in 2021. All articles are searched through Google Scholar. The keywords used to complete the search for related articles were “organic waste”, “compost”, “effective microorganisms”, “and bio activator”. The focus of the article being sought is the use of various kinds of bio activators to speed up the composting process and produce good compost. The bio activators discussed are MOL (vegetable, fruit, and coconut pulp waste), EM4, Organic, Rumen cattle, and Lindi. Good research is the RAL method with various treatments and replications to find out the combination of good bio activators for composting.

III. RESULT AND DISCUSSION

3.1. parameters of pH value, temperature, and water content using various bio activators

Several studies on the use of bio activators for the composting process have resulted in several good bio activators according to SNI (Standard national Indonesia) 19-7030-2004. seen from the parameters of pH, temperature, and water content, where if these parameters are by SNI then the benefits of using compost for agriculture will result in increased crop yields. The following is a summary of the optimal values of pH, temperature and water content using various bioactivators.

TABLE 1. THE USE OF SEVERAL BIO ACTIVATORS TO START THE MANUFACTURE OF ORGANIC FERTILIZERS.

Bioactivator	pH	Temperature (^{0}C)	Moisture Content(%)	Source	SNI
Orgadec	6.96-7.45	-	15.19-25.63	Resman,2021[6]	
Rumen (150 and 250 gr)	7.4-7.6	29-29.5	-	Indasah,2021[7]	pH=6.80-7.49 Temperature = - Moisture Content = <50%
Coconut pulp LMO (200.000 ppm)	7	37,12	-	Darwel,2021[8]	
Cow dung+rumen 15%	-	-	45,86	Pancapalaga,2021[9]	
Leachate	7.20-7.80	26.5-31	-	Chusna,2021[10]	

Based on several studies above, the use of bio activators that have been studied by several researchers obtained several bio activators with various compositions for the composting process. Bio activators are biologically active ingredients used to increase the activity of the composting process. The use of bio activators in composting has an effect on the supply of nutrients in it. The types of microorganisms present in the bio activator can affect the chemical content of the compost produced. The composting speed process is not only determined by the abundance of microorganisms but is also determined by the amount of composted material [11].

Organic (Organic Decomposer) is a composting bio activator with native Indonesian microbes produced by the Indonesian Plantation Research Institute (LRPI). The microbes in the Orgadec bio activator used in composting are *Trichoroderma Pseudokoningii* and *Cytophaga* Sp. Both of these microbes have a high ability to produce enzymes that destroy lignin and cellulose simultaneously [12].

Beef rumen also contains nutrients that are used by microbes as a source of energy. There are cellulolytic bacteria and ligninolytic bacteria which are used to degrade cellulose and lignin. Lignin-degrading enzymes are produced by actinobacteria of the genus *Streptomyces*. Cow feces contains 18.6% hemicellulose, 25.2% cellulose, 20.2% lignin, 1.67% nitrogen, 1.11% phosphate, and 0.56 potassium. %. Cow feces has a C/N ratio of 16.6-25%. The range of the C/N ratio between 25-30 is the optimum range for the anaerobic decomposition process [13].

Dried coconut pulp (fat-free) contains 93% carbohydrates (61% galactomannan, 26% mannose, and 13% cellulose). [14] found the presence of cellulosic bacteria in coconut pulp that can produce cellulase enzymes which are one of the important hydrolytic enzymes in the degradation of organic waste [15].

Leachate contains microbes and various kinds of minerals needed for bacterial growth. Leachate generally contains organic compounds (hydrocarbons, humic acid) and inorganic compounds (sodium, potassium, calcium, magnesium, chlorine, sulfate, phosphate, phenol, nitrogen, and heavy metal compounds). The leachate can be processed into biogas, liquid fertilizer, or microbial starter [16].

Bio activators that have been used for the composting process, namely Orgadec, coconut pulp mole, rumen, and leachate, have yields that are by SNI, based on these results, a combination of these bio activators can be used for the composting process to produce good compost. The bio activator that has been used has cellulolytic, and ligninolytic bacteria and also has a source of N, C, and P which are useful for microbial metabolism and produce enzymes to hydrolyze organic matter content consisting of lignin, cellulose, and hemicellulose.

pH during composting increases from acidic to neutral or alkaline conditions. This is due to the production of ammonia from nitrogen-containing compounds derived from vegetables. The pH of the compost that is neutral or ideal is caused by microorganisms from the bio activator that can make changes. The more cellulose and lignin content in organic material, the more humic acid, and fulvic acid content are in line with the decomposition process of the organic matter[17]. The low water content in the compost is caused by the microorganisms in the compost pile working effectively and the high evaporation rate so that the water content in the compost will be reduced. The decrease in water content in aerobic composting occurs because the water content in the compost material evaporates due to heat, stirring, and the consumption of microorganisms to convert protein into nutrients needed by plants. The high water content in compost is caused by microorganisms that do not work effectively so evaporation in the compost pile is reduced [18].

The higher the temperature, the more oxygen consumption and the faster the decomposition process. The increase in temperature is related to the activity of microorganisms in decomposing organic matter, which produces energy in the form of heat, CO2, and steam. The heat generated by fermentation is correlated with the growth curve of microorganisms. After reaching its peak, the fermentation temperature will decrease which is thought to be caused by the decreased activity of microorganisms in the decomposition of organic matter.

3.2. Parameter values of P, N, C and C/N Ratio using various bioactivators

Bioactivator	**Phosphate (%)**	**Nitrogen (%)**	**Carbon (%)**	**Ratio C/N**	**Source**	**SNI**
Orgadec	1,73	2.1	34,63-36,82	10,38-20,25	Resman,2021[6]	N=>0.40 % P=>0.10 % C=9.30-32% C/N=10-20
Rumen (250 gr)	0,29	0,81	8,47	45,75	Indasah,2021[7]	
Cow dung +rumen 15%	0,15	1,59	30,60	19,24	Pancapalaga,2021[9]	

Based on research using several bio activators, three bio activators have the best value and according to quality standards, namely orgadec, cow rumen, and cow rumen with cow dung. This can be done further research to test the combination of several activators that have been studied to have optimal results.

The increase in total P content was caused by microorganisms in the bio activator working faster so that the metabolism of microorganisms produced phosphate minerals. The increase in phosphorus levels is thought to be the impact of the activity of microorganisms that convert glucose in organic matter into lactic acid so that the environment becomes acidic. The lower the total P, the greater the number of microorganisms in the compost which causes high competition between microorganisms for food sources. Substance P is an organic material, so it is essential for soil fertility. The phosphorus content is also affected by the high nitrogen content. The higher the nitrogen, the higher the P content [19]. The high total N is due to a faster composting process, so the total value of inorganic N in NH4+ and NO3 compounds from the fermentation process of organic matter (protein) will also

increase. The low total N value is due to competition between microorganisms in the compost pile so the fermentation process does not run smoothly [20].

The high organic C is caused by a large number of microorganisms in the compost pile with a limited number of food sources, causing competition between microorganisms, and microorganisms to decompose carbon compounds as an energy source in the composting process[21]. Optimal C/N levels are caused by microorganisms that work optimally so that microorganisms decompose organic matter, which results in the loss of carbon due to CO2 evaporation. The longer the decomposition process, the smaller the C/N ratio. Carbon content in compost material is much reduced because it is used as a source of food/energy[22]. There are benefits of macronutrients for plants, namely as follows:

Macronutrients	Function
NITROGEN (N)	• Stimulates vegetative growth of plants • Plays a role in the formation of leaf green matter (chlorophyll) • Play a role in the formation of protein, fat
PHOSFHOR (P)	• Serves to stimulate root growth • Assist the assimilation process • Accelerate flowering and ripening of seeds and fruit
KALIUM (K)	• Serves to help the formation of protein and carbohydrates • Strengthen plants so that leaves, flowers and fruit do not fall off easily. • One source of plant resistance to drought and disease.
CALCIUM (Ca)	• Serves to stimulate the formation of root hairs

[23]

3.3. Composting time using various bioactivators

Several activators have the fastest composting time, namely coconut pulp mole and beef rumen, where coconut pulp mole contains nutrients for microbial growth such as cellulose and there are cellulolytic bacteria as remodelers of chemical compounds that make up organic waste. In addition, the cow's rumen contains various types of microbes such as cellulolytic bacteria, fermenting bacteria, and fungi that play a role in hydrolyzing the compounds that make up organic waste, where the more microorganisms that work and the source of nutrients in the bio activator, the faster the decomposition process of organic waste[24].

3.4. Composting Process

This composting stage includes:

(i) active phase (decomposition): When the microbial population starts to increase the degradable organic matter increases, then heat generation by microbial activity accumulates in the pile and the temperature continues to increase through the mesophilic (25–45°C) to thermophilic (more than 45 °C). Thermophilic temperatures (55 C and above), temperatures above about 65 °C kill many microbes and limit the rate of decomposition, compost managers use aeration and stirring to keep the temperature below this point.

(ii) cooling phase: When the energy supply is exhausted, the temperature of the compost gradually decreases and mesophilic microorganisms once again dominate the compost heap.

(iii) ripening phase: It occurs at a lower temperature, but still many reactions occur during this phase, even though the microbial activity is relatively low compared to the previous stages. One of the characteristics in this stage is the humification of the material, which gives good value to the compost produced

3.5. Synthesis

Synthesis from references after reviewing several articles there are several ideas for further research where there are problems with organic waste from various sectors that are used for the manufacture of organic fertilizers, where at this time the manufacture of organic fertilizers uses bio activators to speed up the decomposition process but the use of commercial bio activators is often used. not optimal in producing organic fertilizers so further research needs to be done, namely the use of various local microorganisms as bio activators.

The ideas for further research are:

1. Bioactivator 1: The use of local microorganisms from sources of fruits, palm sugar, and carbohydrates containing carbohydrates as a source of energy for microbes Coconut coir contains minerals. So that the decomposition process of organic matter will be faster if the source of microbial decomposers is sufficient
2. Bioactivator 2: the use of yeast tape, tape, Tempe which consists of bacteria, fungi, and yeast so that the more microorganisms that work, the faster the composting process
3. Bioactivator 3: from bovine rumen containing cellulolytic bacteria, nitrogen source urine, and blood as a protein source for decomposing bacteria[25].

By using a combination of these bio activator formulations, the decomposition process of organic waste is faster and shows optimal results.

3.6. Disadvantages and advantage of reviewed articles:

1. The previous article only used one or two bio activators and the observed parameters were incomplete, so it is necessary to combine bio activators for further research the observed parameters must be completed again based on SNI so that we know the quality of the compost we make.
2. Advantages of reviewed articles:

The previous article has examined bio activators and the concentration which has optimal ability in the composting process, it is hoped that these results will become a reference for future compost researchers in selecting or combining bio activators.

IV. Conclusion

This study presents a literature review on the use of various bio activators to speed up the composting process and produce good quality compost. The compost can be applied to sustainable agriculture. Literature analysis shows that there are various bio activators available that can be combined to improve compost quality and accelerate the rate of composting. Various kinds of literature obtained optimal results from bio activators, namely beef rumen, mole (coconut pulp, vegetables, and fruits), and orgadec this can be a reference or information for the use of bio activators for composting in the future.

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