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STUDY ON COMPOSTING OF DIFFERENT WASTE USING INDIGENIOUS MICROORGANISMS (IMO) – A REVIEW

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Abstract:

In the municipal solid wastes contain the component of organic solid waste like food waste, garden waste, paper waste,etc. that disposed directly into the landfill. Composting has been used as a means of recycling organic matter back into the soil to improve soil structure and fertility and ability to improvement in crop growth. The composting process has received much attention in recent years because of pollution concerns like air, water, soil pollution and the search for environmentally sound methods for treating waste. Waste volumes is continue to rise, which leads to loss of resources and increased environmental risks. Open dumping and sanitary landfill is a major method for waste disposal, the Land filling of biodegradable waste is proven to contribute to environmental degradation, mainly through the production of highly polluting leachate and methane gas .Composting shows that the stabilization of waste for land filling, volume and mass reduction of solid waste and return of organic substances to the natural cycle. Direct disposal to landfill can cause impacts to the environment. Composting of solid waste is seen as a waste treatment method to avoid the waste from being dumped at the landfill. The utilization of organic additives towards composting process would produce an environmental product of compost. IMO used as an organic additive during composting were prepared according to the method from Explain in this study. The preparation of IMO consists of several phases include phase I until V with a mixture of various materials for each phase. This paper reviews information on the composting of different waste using indigenous microorganisms.

Key words. Indigenous microorganisms(IMO), compost, effective microorganisms (EM).

I INTRODUCTION

All across the world, the management of solid waste generation is a major problem, which until now, it is still under major discussion globally . Currently, About 0.16 million ton of municipal solid waste is generated in India every day. Urban Indian generates 62 million ton of waste (MSW) annually, said a 2014 Planning Commission report. According to a 2016 estimate given by the study, India's annual waste generated is likely to touch 387.8 million ton in 2030 and 543.3 million ton by 2050. The World Bank study revealed that India was the world's highest waste-generating nation. In India, the organic waste fraction varies between 40 and 60% of the total solid waste streams. These waste fractions can be utilized through various treatment options, such as composting as organic fertilizer and soil enhancement as well as AD for biogas production. it has become one of the most important environmental issues being discussed and India is no exception to this phenomenon. Eco-friendly MSW management has become a challenging task in India due to the increasing population, unparalleled and unalterable urbanisation, as well as industrial development. Garden waste (GW) is considered as one of the types of municipal solid waste because of its biodegradable organic fraction. Its generally consists tree trimmings, garden litter and trimmings, grass, leaves and other similar constituents . During the dry season, the major component of GW is dry leaves. Traditionally, communities from the suburban and rural areas often openly burn these dry leaves that significantly can cause health problem, as it may contain hazardous chemicals from incomplete combustion. Besides that, another method to dispose of this GW waste was by deposited into landfill or incineration process. However, it is undesirable practices because it occupies valuable agricultural land, produced large amount of greenhouse gases and landfill sites are being filling up at a very fast rate . According to the open burning, limited landfill and greenhouse gases issue, other options are needed to dispose these organic waste materials. The traditional methods like composting process is an environmentally acceptable way to dispose of garden waste . However, about a months to years are required to generate mature compost from garden waste because of the lignin, cellulose and other polymers contain in green waste will inhibit biodegradation and slow down the decomposition process. Composting process is seen as an environmentally acceptable method of waste treatment technology or in the handling of organic solid waste. The benefits of composting are that, based on the living microbes present during decomposition, the results can be good for the environment. Thus, composting can be classified into two categories: aerobic composting and anaerobic composting. The aerobic biological conversion process is a method in which oxygen is supplied to organic material during decomposition. Energy is produced aerobically by microorganisms as organic material undergoes exothermic reactions to facilitate the breakdown of particles of material It is an aerobic, biological process which uses naturally occurring microorganisms to transform biodegradable organic matter into a humus-like product. The utilization of bulking agents usually used during composting process to improve the quality of compost produces. The effectiveness of the composting process is dependent on the ability of microorganisms to maintain the community in obtaining basic needs such as oxygen, optimal temperature, humidity and nutrition. Various methods and techniques have been performed and modified to improve the efficiency of composting process. Among them are by using beneficial microorganism inoculation which has been reported by Biey, could help in improving the efficiency of the composting process. Determination of microbial diversity and community structure of composting has attracted the attention of many researchers in order to answer ecological questions such as the difference in community of microorganisms in the compost maturation. In order to produce mature compost in a short time, presence of the correct microorganisms is needed. This improvement process can be done with the addition of indigenious microorganisms (IMO) into compost to enhance the composting process. IMO is a beneficial member of the soil microorganisms including filamentous fungi, yeasts and bacteria collected from non cultivated soil. It has a high content of microorganisms on the soil with the presence of earthworm castings, often found under bamboo trees. Since microbial community played an important role in decomposed organic matter and lead to compost production, study upon the diversity of microorganisms during composting process is necessary. According to Liu, investigation of the microbial communities in composting ecosystem might help in understanding the compost mechanism. Therefore, monitoring microbial succession during composting process may provide important information of compost quality. In this study we are producing IMO from cooked rice to identify the effect of IMO produced on the composting process.

1.2 Indigenous Microorganism (IMO)

An indigenous microorganism (IMO) is organisms that enrich the nutrient of soil quality and act as a reserve source for nutrient. It contains beneficial microorganisms that play an important role in decomposition of organic matter. Thus, this study was conducted to evaluate the compost quality of IMO-compost by composting the garden waste (dry leaves) with indigenous microorganisms (IMO) as an organic additive. Environmental protection has the foremost importance in the present day life of mankind. Scientists have been researching for technologies naturally available for enhancement of agriculture, management of agricultural waste, etc. Indigenous Microorganisms (IMO's)-based technology is one such great technology which is applied in the eastern part of world for the extraction of minerals, enhancement of agriculture and waste management. Indigenous microorganisms are a group of innate microbial consortium that inhabits the soil and the surfaces of all living things inside and outside which have the potentiality in biodegradation, bioleaching, bio composting, nitrogen fixation, improving soil fertility and as well in the production of plant growth hormones. Without these microbes, the life will be wretched and melancholic on this lively planet for the survival of human race. That is why, environmental restoration and safeguarding target via the indigenous microbes in a native manner to turn out the good-for-nothing and useless waste into productive bio resources is the primary concern of this review. Based on the collection sites, the process of collection and isolation methods are different as they may vary from place to place. Ultimately, in this way to a meaningful and significant extent, we can bridge the gap between the horrifying environmental distress and the hostile activities that have been constantly provoked by human kind—by getting these indigenous microorganisms into action. production of indigenous microorganisms (IMO) and effect on addition of IMO in composting process were done. Production of IMO was done in a series of steps to allow propagation of beneficial microorganisms. Effect of IMO addition in composting process was investigated by having 4 treatments; 1) rice straw without IMO nor manure and rice bran, 2) rice straw with IMO only, 3) rice straw with manure and rice bran, 4) rice straw with IMO, manure and rice bran. Production of IMO using cooked rice yields white molds. Addition of IMO during composting did not affect temperature increment. However, there were differences in numbers of microorganisms found during each stages of composting. Initial composting stage was dominated by mesophilic bacteria and actinomycetes, followed by thermophilic bacteria and later by actinomycetes upon composting completion.

II CHARACTERISTICS OF COMPOST

In order to facilitate use of compost, the material must be characterized both physically and chemically in order to match the compost quality with the intended landscape application and to ensure any state standards or state and federal regulations are met. Of particular concern are identifying and quantifying any metals present in the compost, compost stability, compost maturity, organic matter content, cation-exchange capacity (CEC), nutrient content, and pH. A review of the literature has revealed a wide variation in compost quality and characteristics.

2.1 Physical and Chemical Characteristics of Compost

Physical characteristics of compost include but are not limited to stability and maturity, amount of inert materials, bulk density, and particle size distribution. Stability measurements are used to determine if the compost has cured adequately so that it will not inhibit plant growth or leach excessively. Typically, stability is measured using the Dewar self-heating test or the Solvita test for carbon dioxide respiration, although there is some debate over what test or combination of tests and indicators provides the best means of stability measurement. The CEC has also been used as an indicator of relative stability. The amount of inert materials is an indication of the quantity of glass or other debris that has been incorporated into the compost. The amount of inert material should be limited owing to the health and safety concerns of handling the material with excessive inerts. Particle size distribution is determined through sieving. Particle size distribution affects materials handling and the void ratio and resulting particle size distribution of soil and mulch mixed with compost. Chemical characteristics of compost include pH, percent moisture, percent organic matter, electrical conductivity, CEC, carbon to nitrogen ratio (C:N), metals, and nutrients (including P, K, and N). As mentioned previously, CEC has been used as an indicator of compost stability and the relative ability of a soil to retain nutrients. Higher CEC indicates a more stable compost. The C:N is also an indicator of compost stability. A low C:N indicates instability. pH affects the availability of nutrients, particularly microelements.

III PHASES OF COMPOSTING

Following are the phases of composting process.
a) Mesophilic phase (I).
b) Thermophilic phase (II).
c) Maturing phase (III).
Initial decomposition is carried out by mesophilic microorganisms, which rapidly break down the soluble, readily degradable compounds. As the temperature rises above about 40°C, the mesophilic are replaced by thermophilic, At temperatures of 55°C and above, many microorganisms that are human or plant pathogens are destroyed. During the thermophilic phase, high temperatures accelerate the breakdown of proteins, fats, and complex carboydrates like cellulose and hemicellulose, the major structural molecules in plants. temperature gradually decreases and mesophilic microorganisms once again take over for the final phase of "curing" or maturation of the remaining organic matter.

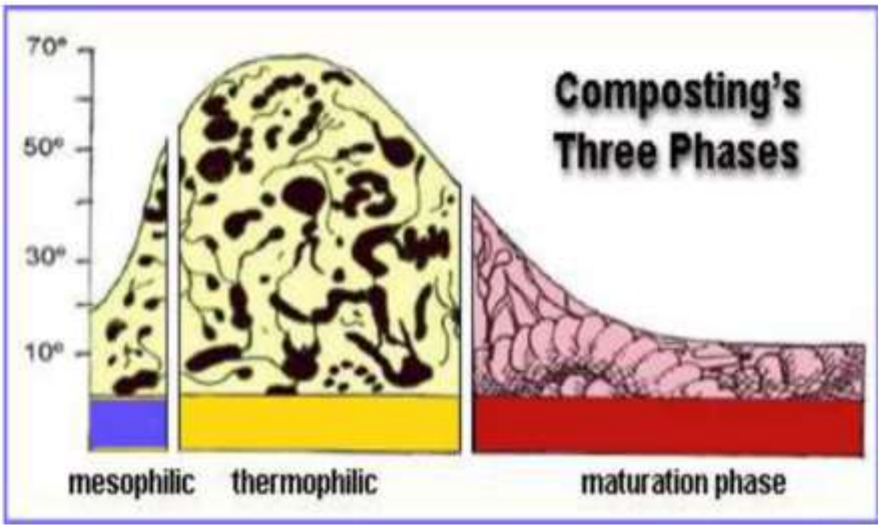

Fig 1. fig shows the phases of composting with temperature.

IV METHODOLOGY

Methodology shows that the use of indigenous microorganisms (IMO) in various composting material in solid waste. It also shows the procedure the result obtained by using the IMO in composting process.

4.1 Composting of organic waste using indigenous microorganisms (IMO).

Composting is a viable means of transforming various organic wastes into products that can be used safely and beneficially as bio-fertilizers and soil conditioners. Problems associated with the use of raw and unstable organic wastes as soil amendments can be resolved through composting, such as malodors, human pathogens, and undesirable chemical and physical properties. During composting, organic wastes are decomposed; plant nutrients are mineralized into forms available to plants, pathogens are destroyed, and malodors are abated . Although, decomposition of organic matter occurs naturally, it can be accelerated by human intervention. Indigenous Micro Organisms (IMO) are naturally occurring microbes that has adapted to the environmental condition where they are found and as such, are capable of accelerating rapid decomposition of organic materials found in the same location. Singh and Sharma, inoculated various kinds of wastes (mixed solid waste, municipal solid waste and horticultural waste) with different micro-flora. Acceleration of decomposition of crop residues high in lignin with the application of IMO has been reported. Microbial inoculation in relation to waste decomposition for agricultural production offers the advantage of releasing essential compounds stored in plants and animal waste to a stable state that can be used again for plant growth . As reported by , microbial inoculants are vital component in the agro-ecosystems as they play an important role in reducing indiscriminate use of chemical fertilizers and offers farmers an attractive economically acceptably substitute for improving soil properties. Microbial inoculant produces metabolites that facilitate decomposition of organic waste and increase humus quality.

4.2 Composting of farm waste and plant material using indigenous microorganisms (IMO)

The study was conducted to evaluate the effect of Indigenous microorganism (IMO) in decomposing compost pile mixtures of farm wastes and plant materials [(carbonize rice hull/ corn husk/ chicken manure/ IpilIpil dry leaves (Leucaena glauca)/ Kakawati dry leaves (Gliridia sepium)] for the purpose of increasing nutrient content values of bio-organic fertilizer. Samples of IMO was collected from a bamboo forest in Potia, Alfonso Lista, Ifugao, Philippines and cultured. Two (2) rates of IMO concentrations (2Tbsp and 3Tbsp) mixed in one litter (1L) of distilled water as treatment was sprayed on 50 kilos of compost pile in a cage bin under a constructed shade. The experiment was laid out in a complete randomized design (CRD) with three replications. Nutrient analysis of compost residues after 30days of decomposition showed increased percentages of macro and micro nutrients with the application of 3Tbsp of IMO. When complex organic materials such as; plants, animal excrements, and organic fertilizers enter the soil, IMO break these down into simpler compounds or elements that can undergo ionic interactions. Compost residues impartmore benefits than fertilization of crops. Compost improves soil structure and tilth, lower bulk densities of agricultural waste, by increasing permeability and porosity. It also creates a favorable environment for microorganisms to produce substances that aids in binding soil particles together. Composting of organic matter before incorporation into the soil is more beneficial than direct application. It helps in stabilizing nitrogen and make is less capable of leaching and reduces odor that is usually produce in decaying organic matter .This study was carried out with the objective of investigating the effect of indigenous micro-organism (IMO) collected from bamboo forest in decomposing farm waste and plant material for the purpose of increasing nutrient contents qualities of bio-organic fertilizer. As a result we get variations in temperature as firstly the temperature is rising till third week then in fourth week the temperature is getting decreases.as in C: N ratio of 40.5 indicating less decomposing activity and thus, a high value of carbon. A major product of plant decay is nitrogen (N) while the undigested portion is primarily carbon (C). A situation as seen in the control treatment can be attributed to the absence of IMO in the compost pile as compared to T2 and T3 with low values of carbon content.

4.3 Uses of indigenous microbes for replacement of chemical fertilizer in agricultural land.

The uniqueness of microorganisms and their often unpredictable nature and biosynthetic capabilities, given specific set of environmental and cultural conditions, have made them likely candidates for solving particularly difficult problems in life sciences and other fields as well. The responsible use of indigenous microorganisms to get economic, social and environmental benefits is inherently attractive and determines a spectacular evolution of research from traditional technologies to modern techniques to provide an efficient way to protect environment and new methods of environmental monitoring. Chemical fertilizers, pesticides, herbicides and other agricultural inputs derived from fossil fuels have increased agricultural production, yet the growing awareness and concern over their adverse effects on soil productivity and environmental quality cannot be ignored. The high cost of these products, the difficulties of meeting demand for them, and their harmful environmental legacy have encouraged scientists to develop alternative strategies to raise productivity, with microbes playing a central role in these efforts. One application is the use of soil microbes as bioinoculants for supplying nutrients and/or stimulating plant growth. Some rhizospheric microbes are known to synthesize plant growth promoters, siderophores and antibiotics, as well as aiding phosphorous uptake. The last 50 years have seen quick steps made in our appreciation of the diversity of environmental microbes and their possible benefits to sustainable agriculture and production. The advent of powerful new methodologies in microbial genetics, molecular biology and biotechnology has only quickened the pace of developments. The dynamic part played by microbes in sustaining our planet’s ecosystems only adds urgency to this enquiry. Culture-dependent microbes already contribute much to human life, yet the latent potential of vast numbers of uncultured— and thus untouched—microbes, is enormous. Culture-independent metagenomic approaches employed in a variety of natural habitats have alerted us to the sheer diversity of these microbes and resulted in the characterization of novel genes and gene products. Several new antibiotics and biocatalysts have been discovered among environmental genomes and some products have already been commercialized. Meanwhile, dozens of industrial products currently formulated in large quantities from petrochemicals, such as ethanol, butanol, organic acids and amino acids, are equally obtainable through microbial fermentation. This review illustrates recent progresses in our understanding of the role of indigenous microbes in agricultural land.

4.4 Composting of Rice Husk on pH of Soilless Media and Yield of Cucumis Sativus using Indigenous Microorganisms (IMO)

A field experiment was conducted to study the effect of Indigenous Microorganisms (IMO) and rice husk on pH of soilless media and yield of Cucumis sativus (cucumber). Ten polybags were provided for each treatment that consisted of IMO treated media (T1), rice husk treated media (T2), and control media (T3). Every treatment was supplied with 1.9 dS/m EC nutrient solutions and the pH was being measured every two consecutive days until the plants had been harvested. Based on the results, there were significant differences in the pH media and the fruit yield between the treatments. The media containing rice husk had a significant increase in the pH media and was consistent in maintaining the average pH media within the range of 6.6 to 6.7, while fruit yield of cucumber recorded the highest number as compared with the other treatments. The findings had revealed that T2 had resulted in 60 cucumbers (22.66 kg) being harvested, followed by T3 with 45 cucumbers (17.53 kg) and T1 with 45 cucumbers (17.11 kg). It can be safely concluded that the medium containing treated RHA was the best for obtaining high yield of cucumber in soilless media as a local growing media due to the superior of its potential constraint of chemical fertiliser while keeping the stability to continue the growth and fruit production for a long period of time.

4.5 Impact of indigenous microorganisms on soil microbial and enzyme activities

The effect of Indigenous microorganisms (IMO's) on the native soil was investigated in the litrature study. Supplementation of IMO's suspension to the soil alters the physico-chemical, biological and enzyme properties of the soil. These alternations include decreases in PH from 7.2 to 6.8, increase in electrical conductivity 0.36 to 1.21 (µmohs/cm), water holding capacity 0.36 to 2.2ml/g of soil of control and test soils respectively. There is increase in soil texture like clay, phosphorous and potassium in the test soil. Enzyme activities such as protease and urease were assessed in both the soil samples with and without amendment of respective substrates (casein and urea). Accumulation of hydrolytic products tyrosine and ammonia from the substrates in the soil was estimated at periodic intervals. Protease and urease enzyme activities were relatively higher in soil amended with IMO's and respective substrate than control.

4.6 Composting of Food Waste using Indigenous Microorganisms (IMO).

Municipal solid wastes usually contain the component of organic solid waste like food waste that disposed directly into the landfill. The objective of this study was to evaluate the performance of composting food waste by using indigenous microorganisms in term of the compost quality (pH, temperature, moisture content, C:N ratio and nutrient content). The compost have been prepared from three different mixtures of food waste for 30 days. The preparation of IMO consists of several phases include phase I until V with a mixture of various materials for each phase. The procedure of IMO preparation is same as the recent study adopted. The composting process was carried out in plastic bin containers. The size of container was 0.29 m height x 0.25 m width, respectively. They were easily available, inexpensive and can readily be used at home. The plastic bin composter was covered with aluminium foil to enable the absorption of heat from the sun. FW were the main materials in the composting process with the inclusion of IMO as additive and CD as a source of nitrogen based on a range of different ratios. Water was added in the course of mixing organic waste with IMO and CD to maintain the moisture content at 40-60%. The FW used to be on a wet weight basis; meanwhile IMO and CD used for composting with FW were on dry weight basis. All the proportions of mixing was in a semi wet-dry weight for FW. The ratios for FW were:
a) Ratio 1; 2:4:1 (1 kg of FW + 2 kg IMO + 0.5 kg CD)
b) Ratio 2; 4:2:1 (2 kg FW + 1 kg IMO + 0.5 kg CD)
c) Ratio 3; 4:4:1 (2 kg FW + 2 kg IMO + 0.5 kg CD)
As a result they find During the composting process, all the parameters of IMO-compost obtained in a range like; pH value 5-9, temperature 29-55oC, moisture content 35-75%, nitrogen 1- 7%, phosphorus 4-15%, potassium 11-23% and C:N ratio 5-20. The result showed that all compost quality for IMO-compost obtained in an acceptable range for final compost to establish.

4.7 Composting of Garden Waste using Indigenous Microorganisms (IMO).

Garden waste (GW) is considered as one of the types of municipal solid waste because of its biodegradable organic fraction.The objective of this study was to evaluate the performance of composting garden waste (dry leaves) by using indigenous microorganisms in term of the compost quality (pH, temperature, moisture content, C:N ratio and nutrient content). The compost has been prepared from three different mixtures of food waste for 30 days. The preparation of IMO consists of several phases include phase I until V with a mixture of various materials for each phase. IMO used as an organic additive during composting were prepared same as the method we adopted.
They collect Garden waste (GW) which consisted of fallen and dry leaves from the School of Environmental Engineering, Uni MAP. GW was dried under the sunlight for 3 days and then pulverized to the size of 3 mm using a shredder machine. The purpose of shredding the GW was to increase the rate of the composting process GW was analyzed for pH, moisture content and C:N ratio before composting

process was performed. Dried chicken dung (CD) was used since it was difficult to obtain fresh chicken dung. The CD was mixed with GW and prepared IMO during the composting process as a source of nitrogen. The CD was obtained from a commercial chicken farm in Pauh, Perlis and it was characterized for pH, moisture content and C:N ratio before used. In the composting process was carried out in plastic bin containers (0.385 m height x 0.42 m width) and covered with aluminium foil to enable the absorption of heat from the sun. GW was the main materials in the composting process with the inclusion of IMO as additive and CD as a source of nitrogen based on a range of different ratios. Water was added in the course of mixing organic waste with IMO and CD to maintain the moisture content at 40-60%. They used the following ratios for GW composting :

a) Ratio 1; 2:3:1 (2kg GW + 3kg IMO + 1kg CD)
b) Ratio 2; 3:2:1 (3kg GW + 2kg IMO + 1kg CD)
c) Ratio 3; 2:2:1 (2kg GW + 2kg IMO + 1kg CD)

As they find During the composting process, all the parameters of IMO-compost obtained in a range like; pH value 8-9, temperature 30-48°C, moisture content 36-65%, nitrogen 2- 7%, phosphorus 4-8%, potassium 12-18% and C:N ratio 6-12. The result showed that all compost quality for IMO-compost obtained in an acceptable range for final compost to establish.

V CONCLUSIONS

The study showed that IMO addition in composting increased microorganisms which are responsible in organic decomposition. This literature study gives the idea about the whole composting process i.e. various phases and parameters of composting process, the dynamics of waste degrading microbes and enzymatic activities involved during composting process. Composting being a slow process involving biological waste stabilization makes unattractive for implementation. The study suggested that the use of IMO as additives can be utilized during the initial stage of composting in order to influence the composting parameters (pH, temperature, moisture content, etc.) favourable composting process. The additives also stimulate the growth of waste degrading microbes and enhance the enzymatic activities. As use of IMO due to their porous nature facilitate proper and improved aeration in compost piles. Certain techniques like aeration, periodic waste turning, shredding of the bulky raw waste are also found to be effective in accelerating the composting process. The additives containing minerals also increase the nutrient content of final compost though the initial feed stocks are nutrient rich. Hence, the utilization of chicken dung to the accelerated composting process and the final compost has higher nutrient content.

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