JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

STUDY ON COMPOSTING OF VEGETABLE WASTE

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Abstract: India generates more than 42 million metric tonnes of solid waste annually. A major strain has been placed on the waste management infrastructure as a direct consequence of rapid urbanisation. The annual fruit and vegetable yield in India is estimated to go to waste due to spoilage at a rate of 18 percent. If you have organic waste, composting is the best way to recycle it right now. Vermicompost, which differs from traditional compost in that earthworms are used in the decomposition process, is another kind of compost. Microorganism inoculants are expected to have a significant role. Environmentally complex agriculture practises like microbial inoculation provide a novel approach to increasing crop yields while decreasing the amount of inorganic fertiliser required. Soil inoculants, sometimes comprised of microorganisms, are routinely sprayed to improve crop yields and human health. Everybody knows that composting takes a long time and is a continual process. This is what first piqued their interest in using vermicomposting and microbial inoculants to enhance the compost's properties and reap the most benefits. The concept of combining these three strategies into compost was born as a consequence. To enhance soil quality and stimulate plant development, we need to devise a plan to incorporate vegetable market waste into agricultural practises. Plants like cabbage, onions, and bananas are ideal for this experiment's target audience: farmers who cultivate these sorts of fields. Furthermore, the experiment aids in highlighting the difference between compost made from separated waste and compost formed from mixed vegetable waste.

Index Terms **– Compost, Vermicompost, Microbial Inoculant, Microbes, Bin Composting, Additives.**

I.INTRODUCTION.

The proper disposal of garbage is a pressing problem in developing countries like India, where the term "solid waste management" has gained prominence. The population of India is predicted to reach 138 crores by the year 2020, with subsequent annual growth of 3.5%. Considering that population growth is around 1.3% per year[1], the annual increase in waste production is about 5%. In the twenty first century, the agriculture and food industries of the globe will face formidable obstacles. Two of these extra concerns that stand out as especially urgent are food safety and effective waste management. Increases in both landfill and incinerator food waste have been observed[2]. Vegetable market waste is a common source of anger in India since it is deposited in landfills and dumps together with other trash. Greenhouse gases released into the environment, leachate produced, and odours produced all contribute to this annoyance. The proper disposal and recycling of unwanted vegetables has recently emerged as a pressing ecological concern. Fast population and economic growth in India over the last several decades has resulted in an equally rapid rise in the country's waste output, most of which consists of discarded vegetables. India's rising middle class is largely due to the country's rising living standards. Every year, India generates roughly 150 million tonnes of fruit and vegetable production. Roughly 50 million metric tonnes of this total is rubbish, which is causing issues at municipal landfills and contributing significantly to pollution issues in the environment. Therefore, regulating these organic fractions is essential for safeguarding the environment and making the most of the process's by-products, independent of the technique used. Composting is becoming more popular as a technique of disposing of organic waste since it offers more financial and environmental benefits than the other primary waste management technologies and ultimately yields a more stable product. The end result may be utilised to improve and maintain soil fertility. Producing compost from vegetable waste and using it as a regular soil conditioner has been shown to boost the soil's organic matter content and carbon-to-nitrogen (C/N) ratio compared to unamended soil[3]. To complete the biological oxidation of organic materials, the composting process requires a rapid and dynamic succession of populations of aerobic bacteria. Composting as an exothermic process clarifies this phenomenon. Composting is an effective method for handling large quantities of these organic wastes.

Reusing organic materials via composting is highly recommended. Since composting materials require time to breakdown and grow, it is a time-consuming process. Vermicomposting and the use of microbial inoculants are two ways to enhance the quality and usefulness of compost. To that end, we must devise a plan to reuse the waste generated by vegetable markets in agro - ecosystems, where it may enhance soil quality and promote plant development. The goal of this research is to optimise the three

composting methods and compare their relative performance. Cabbage, onion, and banana growers are the major focus of this research. The experiment also helps distinguish between standard compost made from garbage and vegetable materials and compost made from separated garbage.

The current endeavour is centred on the practise of composting vegetable waste in a bin to produce high-quality compost that contains nutrients in a form plants can use. From what I can see, scientists are trying to find ways to hasten the composting process by including additives like commercial vermicompost, microbial inoculant, and natural accelerating components like banana peel, onion peel, and sawdust as a bulking agent into the mix.

II.METHODOLOGY

The methodology used for tuning the vegetable waste into a good quality compost is discussed here. This subtopic also describes the procedure adopted for carrying out the study of accelerating ingredients in composting technique and preparation of the compost. the methodology includes various phases of work, that is collection of raw vegetable waste from vendors, procurement of accelerators and bulking agent, setting up of bin composters, collection of samples, determining various characteristics of samples and recording the results of the laboratory test.

2.1 Collection of materials.

To perform biological degradation during composting to get a good quality composed following materials were used.

1. Vegetable waste.

All the vegetable waste required for the study was collected from various vegetable vendors in local market of Amravati. the collected Waste was then shredded for reducing the volume of waste.

2. Sawdust

Sawdust is formed of small particles of food and it provides the free airflow, moisture regulation, and maintains the carbon to nitrogen (C: N) ratio[4]. An adequate aeration during composting is necessary for proper composting as to generate a good quality and matured compost. Low aeration rate might lead to anaerobic conditions, while a high aeration rate might result in excessive cooling, that's preventing thermophilic conditions. due to many pores and low moisture content, bulking agent support the creation of inter and intra particle voids[5].

3. Onion peels

Onion skin and peels have antioxidant characteristics and include numerous important components including sulphur, potassium, phosphorus, zinc, iron, vitamins. the onion peels contain roughly 54% of volatile solids with 1.5% dry weight of lignin. onions are one of the key vegetables used in India and onion fields are the most common trash discarded in practically every kitchen. In the study onion peels were chosen as they are widely obtainable, can act as moisture adjuster due to their low moisture content and have high levels of cellulose which can be an excellent carbon source[6].

4. Banana peels

Banana peels provides several benefits as they are a major source of soluble and insoluble fibre, antioxidants. Moreover, the skin of a banana contains various minerals and metals including potassium, phosphorus, calcium, magnesium and manganese. banana peels represent roughly 18 to 33% of entire fruit bulk and are considered as a waste product. at present, these peels are not being used for any other applications and are usually disposed as solid trash at considerable expenditure. Potassium is the most essential element that is used as fertiliser. it is crucial for improving general plant vigour, build up, and resistance to pest and disease which is necessary to assist fruit grow[7].

5. Cabbage Leaves

Cabbage leaves still decompose rapidly in a compost pile, though it is better to break up or cut up complete heads to accelerate the decomposition of the dense portion. Even red cabbages are considered green for composting purposes, thus they are a rich source of nitrogen for your compost pile. Add them to browns if you have a large quantity to dispose of to maintain C: N ratio.

6. Vermicompost

Vermicompost from trust basket claims that it can be used in agriculture (organic farming), greenhouses, orchards, lawns, garden plants, and containers. Vermicompost consists solely of earthworm casts. These worm castings provide nutrients that are water-soluble and readily absorbable by plants. It provides nearly all of the required macro- and micronutrients for plant growth. It improves soil aeration, beneficial microorganism-rich soil devoid of weed seeds, pesticides, and hazardous pathogens. No additives

such as charcoal, coco peat, or soil are present to increase the weight or volume. Vermicompost from trustbasket enhances soil structure and texture, attracts earthworms with deep burrow, increases the capacity to store water, free of weed seeds, hazardous chemicals, and infection, lack any ingredients that would raise its weight or volume, there is no offensive odour, increase the population of beneficial soil microorganisms[8].

Fig 2.1 Trustbasket Vermicompost

7. Microbial Inoculant.

Inoculum is an enzyme and microbial combination that is offered by prions biotech. The inoculum, which is short for "bioaugmentation technology product" is a novel idea in the system for managing solid waste. The Indian biotechnology firm is responsible for the development of its active components (prions biotech). This formulation contains microorganisms that have been encapsulated as well as enzymes that decompose organic debris and an odor-removing material that has also been produced by microorganisms. Benefits: formula that is extremely concentrated. The greatest possible reduction in oil and micronutrients. The greatest possible decrease in the amount of aliphatic and aromatic hydrocarbons helps to eliminate sludge. Effective in a diverse array of contexts and circumstances. Reduced levels of total organic carbon, nitrogen, potassium, and potash in accordance with norms. Perform your duties in both an aerobic and an anaerobic state. Never quits working. Mitigates odor issue, Safe environment friendly, Produces bio-stabilized organic manure that is devoid of disease-causing organisms, noxious odours, and weed seeds. Inoculum's mode of action is significantly superior to that of existing competitive products such as enzymes, bacterial, fungal, and actinomycete strains. Multi-enzymes will be helpful in the speedier cleavage of organic molecules, and further degradation will be handled by endospore-forming bacilli, fungal, algal, and actinomycetes strains as long as the appropriate nutrient supplements and moisture levels are present. Inoculum should be dosed at 10–20 grams per kilogram of trash. Make a compact pile in one of the bins, and then sprinkle inoculum over the top of the garbage. To ensure that everything is properly prepared, rotate the heap once every week. In just four to six weeks, the compost will be ready to use[9].

Fig 2.2 Prions Biotech Inoculum

2.2 Experimental Setup for Bin Composter.

Five bin composters were utilised for this study. One bin composter was utilised for standard composting without additions or bulking agents. In contrast, the other five composters contained both additives and bulking agents. The compost container is manufactured of polypropylene, has a cylindrical shape, weighs 1.8 kilogram, and measures 40 x 36 x 42 centimetres.

The drum features a lid that aids in preventing odours, flies, and rodents. The composter has a capacity of 25 litres. In addition, it includes a tray with microscopic holes. The aim of the holes is to allow leachate to seep to the bottom of the container. The net was installed on the tray's base to prevent the dirt and vegetable debris from escaping. The tap can be used to drain the leachate.

Fig 2.3 Bin Composter

Experimental Process.

In order to carry out the experiment, the trash from the raw vegetable market was gathered, shredded, and then put through the composting process. The method of composting that was used in this research was the bin composting method, which was chosen since it speeds up the composting process. The composter was filled with alternate layers of vegetable waste with vermicompost and sawdust. the microbial inoculants were sprinkled on the top most layer along with the sawdust. bin composter no 1 was made using vermicompost (including worms) having Vegetable waste 6 kg and sawdust 9 kg, Bin composter no 2 was made using traditional method Using same proportion of waste. Composter no 3, 4, 5 were made using readily available vermicompost and microbial inoculant Also using natural accelerating agent such as Main ingredient (cabbage leaves, banana peels, and onion peels) respectively. After the compost had time to mature and was prepared for use, it underwent additional testing to determine its chemical and physical properties, and the results of that testing were analysed. The matured compost can be investigated for physical, chemical, and biological parameters to check its maturity and stability. All the chemical analysis were performed on the samples in its natural state.

III.RESULTS AND DISCUSSION.

The trend towards more efficient methods of compost production and handling requires a complete understanding of the process, the materials involved, and the physical and chemical parameters of the compost such as pH, moisture content, total carbon, total nitrogen, total phosphorus, total potassium, NPK ratio and C: N ratio. these parameters influence the process and product in various ways from aeration effectiveness to compost soil interaction thus it is extremely important to analyse these parameters to know the compost in better way.

3.1 Analysis of compost samples.

Various tests were performed on the compost samples which are pH, moisture content, total carbon, total nitrogen, total phosphorus, total potassium, NPK ratio, C: N ratio. The characteristics of the compost samples are presented in the table.

Table 3.1.1 Test results for Samples (1-6)

Samples	% Carbon	Nitrogen	Phosphorous	Potassium	pH	C: N Ratio	Moisture Content
Sample 1	24.08	0.8	1.42	2.38	8.129	30.1	58
Sample 2	18.93	0.53	0.74	0.53	8.569	35.71	43
Sample 3	21.58	0.53	0.88	0.53	7.08	40.71	32.8
Sample 4	26.33	0.8	0.51	0.97	9.474	32.91	62
Sample 5	30.62	2.13	1.07	3.7	8.52	14.37	45
Sample 6	15.68	3.72	1.33	3.6	6.5	16.46	28

1. Effect of Additives on pH of the final compost.

The pH is a measure of active acidity in the feedstock or compost. the pH scale is 0 (acidic) to 14(alkaline) with 7 (neutral). A lower pH preferred for certain ornamental plants while a neutral pH suitable for most applications. The pH varies during composting with a decrease during the early stages and an increased during the later stages which affects microbial activities. Some additives are used to increase the pH and thus enhance the composting of acid feedstocks such as food waste. The use of bulking agent such as paper, peanut shell, sawdust etc might also increase the pH during composting. For experiment, sawdust was used as bulking agent which help in maintaining the ideal pH range of 6.5 to 7.5, according to the compost quality standard as per solid waste management rules, 2016; fertiliser control order, 2009; and fertiliser control order, 2013[31]. The optimum pH range for compost containing vermicompost is 7.5 to 8. The acceptable pH range for a compost containing vermicompost is 4.5 to 9. Therefore, according to the report, sample 1, 2, 3, 5, 6 are under acceptable range. Microorganisms cannot survive in environment that are too acidic or alkaline. also when the pH is greater than 9, nitrogen is more rapidly converted to ammonia and becomes biologically unavailable, increasing the C: N ratio and slowing the process.

2. Effect of additives on moisture content of the final compost.

The moisture content during composting influences the oxygen uptake rate and thus the microbial activity and the degradation rate. Optimal moisture content hence decreases along the compost maturation time. the optimal water content for organic matter biodegradation has been estimated between 40 to 70%. however general, organic waste have higher moisture content. for example: vegetable waste has initial moisture content of about 80%. search high humidity me favour anaerobic conditions and thus causes various problems like easy putrefaction, offensive odour, and pollution of ground and surface water by leachate during composting. The bulking agents commonly chosen to offset the high moisture content of organic waste are fibrous materials which can absorb part of the Leachate. leachate absorption may be achieved by sawdust. therefore, it has also been observed that increasing water absorption capacity buy sawdust edition also results in higher degradation rate due to more air flow through the particles. The test

results of moisture content for sample 1, 2, 4, 5 are under acceptable range that is between 40-60%[33]. Also due to the addition of sawdust there was almost no leachate discharge collected in the bucket.

3. Effect of additives on NPK of the final compost.

Nitrogen helps in production of new cells and enzymes. it also facilitates the production of green pigment responsible for leaf and stem growth. does helping plants with rapid growth. According to the compost quality standards as per solid waste management rules 2016, the standard value of total nitrogen is 0.8% by weight (minimum). According to the test results, Sample 1, 4, 5, 6 satisfy the given standard. The samples containing additives have higher values of nitrogen. The total nitrogen includes all forms of nitrogen: organic nitrogen, ammonium nitrogen (NH_4-N), and nitrate nitrogen (NO_3-N). the nitrate nitrogen is generally present in only low concentration in immature compost, although may increase as the compost matures. Ammonium nitrogen levels may be high during initial stages of the composting process decrease as maturity increases. Organic nitrogen is determined by subtracting the inorganic nitrogen forms from total nitrogen. In stable, finished composed most of the nitrogen is in the organic form also, ammonium nitrogen and nitrate nitrogen at immediately available to plants, organic nitrogen is only slowly available.

Phosphorus encourages root growth and blooming. It reaches down the roots of the plant and helps in producing blooms. It is also an essential part of the process of photosynthesis does helping in the transformation of solar energy into chemical energy. Phosphorus is a plant macronutrient. The total phosphorus test results provide an indication of the nutrient value of the compost sample. According to the compost quality standards as per solid waste management rules, 2016; fertilizer control order, 2009; and fertilizer control order, 2013, the standard value of Total P is 0.4% by weight (minimum). According to the test results, the total phosphorus for all the samples is above 0.4% which satisfies the condition. the samples with additives have higher values of phosphorus as compared to the traditional compost.

Potassium helps in encouraging the uptake of water. it is also an essential nutrient for the development of flowers and fruits potassium also increases plants resistance to diseases, helps plant make better use of light in air. According to the compost quality standards as per solid waste management rules, 2016; fertiliser control order, 2009; and fertiliser control order, 2013, the standard value of total K is 0.4% by weight (minimum). According to the test results the total phosphorus for all the samples is above 0.4% which satisfies the condition. the samples with additives have higher values of potassium as compared to the traditional compost. Potassium is essential for promoting general plant vigour, build up, add resistance to pest and diseases which is necessary to help fruit grow and also involved in regulating around 50 enzymes in a plant[34].

4. Effect of additives on C: N ratio of the final compost

This is the ratio of total carbon to total nitrogen in the sample. C: N ratio may be used as an indicator of compost stability and nitrogen availability. compost C: N ratio typically decreases during composting if the starting C: N ratio is > 25 but may increase if the starting C: N ratio is low (< 15). And N is lost during the composting process. compost with high C: N ratio (>30) will likely immobilise nitrogen if applied to soil, while those with low C: N ratio (<20) will mineralize organic nitrogen to inorganic nitrogen. Thus the C: N ratio is an indication of compost maturity. the carbon provides the primary energy source for microbial metabolism, and nitrogen is critical for microbial population growth. According to the compost quality standards as per solid waste management rules, 2016; fertiliser control order, 2009; and fertiliser control order, 2013, the standard value of C: N ratio is 25:1 to 30:1 during active composting, 18:1 to 23:1 During curing period, 15:1 to 20:1 for final product. The acceptable range is 20:1 to 40:1 for vermicompost. According to the results sample 1, 2, 3, 4 are in the acceptable range for vermicompost. Sample 5, 6 satisfy compost quality standards as per SWM rules.

CONCLUSION.

Research work was undertaken to analyze and compare traditional compost and compost made using different additives. It was also done to study the effect of various additives and bulking agents on the composting process for the treatment of vegetable waste which is the major issue in MSWM if just dumped into landfills. On the basis of the test results following conclusions can be drawn: Vegetable market waste is a major issue in municipal solid waste management, due to its high moisture content, it creates a lot of nuisance and forms leachate when just dumped into landfills. With the help of a bin composter it is possible to compost the vegetable market waste at the point of generation itself, minimizing the load on landfills. The compost made from the traditional method is a good quality compost, but it requires several months to mature.The compost made from the addition of vermicompost requires less time as compared to the traditional composting method and also it enhances the compost parameters drastically. As we can see from sample 1 and sample 2, the compost parameters of sample 1 are increased because of the addition of vermicompost roughly by 27%. The time necessary for sample 2 to develop was roughly 120 – 150 days. Whereas the period necessary for sample one to mature was roughly 60 to 75 days. Sample 3, sample 4, and sample 5 are made from segregated waste (cabbage leaves, banana peels, onion peels) which were composted for 45 days. Targeting their application for the farmers with certain sort of farm. In these samples, vermicompost and microbial inoculant were introduced. If we review the parameters of sample 2 and sample 3, the nitrogen concentration and potassium content are equal, but the period necessary for sample 2 to get that results were nearly double as compared to the time required for sample 3. The phosphate in sample 3 is relatively more than in sample 2. If we analyze the parameters of sample 2 and sample 4, the nitrogen and potassium concentration is high in sample 4. Also the parameters of sample

5 with regard to sample 2 are substantially higher due to the variable ratio of green and browns. Lastly, the parameters of sample 6 is of the vermicompost itself which contains a very high nitrogen content as well as potassium content, also phosphorous content. In accordance with the requirement of the crop, we can add a suitable number of greens and Browns to attain the desired result. In sample 1, 2, 3, and 5 the pH is within the recommended limits. In sample 4 the pH value is 9.474, which is due to considered ratio of greens and browns. In sample 6 the pH value is 6.5, which is of the readily available vermicompost as it contains very less amount of Browns. The moisture content of sample 1, 2, 4, and 5 is between 40 to 70%, which can be considered good due to its balanced Greens to browns Ratio. Similarly the C: N Ratio for sample 1, 2, 4, and 5 is around 25 – 40, which can be considered good. The study has shown that we can get a balanced C: N Ratio if we have balanced greens to brown materials in the compost. Sample 3 Has pH value 7.08 which is okay, The moisture content is 32.8 percent which is low, due to more quantity of carbon than nitrogen. as the carbon material (sawdust) retails all the moisture but due to the lack of greens the compost become dry. Similarly the C: N ratio is 40.71 which also indicates high carbon than nitrogen. due to the lack of moisture, the microorganisms are hard to survive and therefore it slows down the composting process. Sample 6 have pH value 6.5. we can add browns to neutralize it. High C/N ratios can lead to prolonged composting duration and low C/N ratios enhance nitrogen loss.

ACKNOWLEDGMENT

To achieve any goal successfully takes the work and efforts of a large number of individuals. For this reason, I would like to express my gratitude to the Principal of the Government College of Engineering in Amravati, the Head of the Civil Engineering Department, and my Guide Dr. M. N. Hedaoo for their support.

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