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ISOLATION, CHARACTERIZATION, AND APPLICATION OF ORGANIC WASTE DEGRADING MICROORGANISMS

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ABSTRACT: Organic wastes are wastes that easily biodegradable. Agricultural trash, market waste, kitchen garbage, urban solid food wastes, and municipal solid waste are all sources of these wastes. These wastes, if not properly managed, could cause a slew of environmental issues.As a result, composting is the most cost-effective solution to this problem.All forms of organic wastes, such as fruits, vegetables, plants, yard wastes, and others, can be degraded using the composting method.The composition from organic waste that could be use as nutrients for crops, soil, additive and for environmental management. Many factors can contribute to the quality of the compost products as different types of organic wastes have different concentration of nutrients, nitrogen, phosphorous and potassium (N, P, K,) which is the common macro nutrients presents in fertilizers. Temperature, pH, moisture content, and the carbon nitrogen ratio (C: N) are the primary characteristics that contribute to the composting process effectiveness.

Key Words: Decomposition, Organic Waste, Bio degradation, composting, Market waste, Fertilizers.

INTRODUCTON:

Organic wastes are trash that degrades quickly. Agricultural trash, market waste, kitchen garbage, urban solid food wastes, and municipal solid waste are some of the origins of these wastes. The organic portion of trash contains around 75% sugar and hemicelluloses, 9% cellulose, and 5% lignin, carbohydrate amino-acids, peptides, and protein, volatile acids, fatty acids, and their esters, and volatile acids, fatty acids, and their esters .Through the use of innovative technologies, organic waste can be turned into organically beneficial goods and utilised for energy, organic fertilisers, and animal feed. (Choi & Park, 1998)

The amount of organic materials in waste is referred to as biodegradable waste. Biodegradable trash is often found in municipal solid waste (MSW) in India's cities, where organic matter content ranges from 75 to 85%. The amount of organic matter in waste varies depending on the economic situation of the country where it is created.The major goal of this research was to create a microbial consortium that could be used as a biological tool for removing organic solid wastes from the environment and using the compost that resulted from the degradation to improve soil fertility. (Bardos, R. P *et al*., 1991)

Microorganisms found in dump soils are exposed to a variety of substrates and chemicals, making it possible to screen effective bacterial strains with useful applications. Rapid organic waste degradation necessitates the use of microorganisms with high enzyme activity to break down complex polymers into smaller compounds that can be degraded. As a result, inoculating waste with microorganisms that produce extracellular enzymes such cellulase, amylase, protease, pectinase, and lipase at higher levels accelerates waste decomposition, assisting in maintaining waste degradation rates comparable to those of garbage dumping (Bandara *et al.*, 2007).

Organic Waste

Organic waste can be defined as organic material that is easily biodegradable. Organic material is derived from natural sources. Any leftover kitchen waste (vegetable peelings, food, tea bags, and egg shells), agro-waste (food and beverage processing waste, dairy products, animal waste and crops), grass clippings, dried leaves, and lumber are all examples. (Alexander & Clark, 2016)Can degrade naturally. The process of degradation is performed by microbial (fungi, bacteria, actinomycetes, and protozoa) and invertebrate (insects and earthworm) organism, which digest and breakdown the organic matter.Municipal or house hold waste are generated from several sources were variable human activities are encounter. Municipal solid waste from developing countries are generated from house hold (55-80%), followed by commercial or market areas (10-30%) with wearing quantities from street, industries, institutions among others. (J. Y. Wang *et al*., 2003).

Types of Organic waste

Wherever there is human occupancy, organic waste is produced. Household food waste, agricultural waste, and human and animal waste are the most common types of organic waste. Microorganisms break down the organic waste component, resulting in a liquid leachate. If this leachate reaches a watercourse or penetrates the water table, it poses a major threat. Unused food and food waste created mostly from residential (schools, hospitals, universities, offices) and commercial (restaurants, cafeterias, hotels, marketplaces, and industrial) sources are referred to as kitchen trash(Fourti, O *et al.*, 2011).

Kitchen garbage is distinguished by its high organic content, which includes soluble sugars, carbohydrates, lipids, proteins, cellulose, and other biodegradable substances. Unwanted raw or cooked food thrown out during or after food preparation that is no longer fit for consumption or attractive is referred to as food waste. Because food waste has a high moisture content and decomposes quickly, it can have a variety of negative environmental repercussions during storage, collecting, and transportation (Choi & Park, 1998)

Biodegradation of Organic Waste by microorganisms

Biodegradation is an effective bioremediation method. Microorganisms (bacteria, fungus, actinomycetes, and others) have long been recognised to degrade environmental contaminants into numerous chemicals. The transformation of organic pollutants into harmless metabolites or the mineralization of pollutants into carbon dioxide and water are two goals of bioremediation.(Alexander & Clark, 2016a) The activities of microorganisms, primarily bacteria and fungi, breakdown the organic substances that finally end up in the soil. The synthesis of intermediates or end products is accompanied by the breakdown of complex organic materials. Bacteria efficiently carry out these operations, and in the process, they produce a number of enzymes that are useful in a variety of sectors. Microorganisms break down organic materials into carbon dioxide, water, and humus in the presence of oxygen.

Bacteria, fungi, and mesophilic (Streptomyces rectus) and thermophilic (*Actinobifida chromogena, Thermomonospora fusca) Actinomycetes (Actinobifida chromogena, Thermomonospora fusca) Microbispora (Thermopolyspora bispora, Thermomonospora fus Therinomnononospora curvata, Thermoactinomyces spp.)* finally convert organic compounds to inorganic compounds(Buyuksonmez *et al*., 2000) trash to humus.

Microorganisms with increased enzyme activity must break down complicated polymers into simpler degradable components for rapid organic waste breakdown.To speed up the decomposition process, fungal and bacterial cultures are added.As a result, inoculating garbage with extracellular bacteria is a viable option.At higher quantities, enzymes such as cellulose, amylase, protease, pectinase, and lipase are present.promotes waste decomposition, assisting in maintaining the rate of waste degradation to the dumping of garbage. Despite the fact that fungi and bacteria perform distinct roles in degradation, mixed cultures of microorganisms speed up the process. They speed up decomposition by breaking down a wide spectrum of complex chemicals into simpler forms. (Buyuksonmez *et al*., 2000)

Role of micro-organism in biodegradation

The microbial population of soil is made up of five major groups including bacteria, actinomycetes, fungi, and algae and protozoa, and among these groups, bacteria are the most abundant groupas well as the most critical bacteria for waste decomposition. (Alexander & Clark, 2016b). Bacteria use wastes to fuel their metabolism, and as a result, they create a number of simple and useful chemicals that are beneficial to soil health. Plant growing and overall to keep well balance of natural ecosystem. Composting is controlled biodegradation or transformation of organic material, usually under aerobic conditions by which a material is transformed into an end product which is stable and soil like material call compost.Microbes, as well as rodents and insects, play an important part in solid waste breakdown. Bacteria perform the most significant role, and the most effective bacteria can be used to decompose solid organic waste in a controlled manner.

Micro-organisms associated with the wastes include species of fungi viz., *Aspergillus, Trichoderma, Mucor, Penicillium,* Alternaria, *Cladosporium, Monilia, Helminthosporium, Coccidioides, Scedosporium, Actinomycete* viz., *Nocardia* and bacteria viz., *Bacillus, Lactobacilli, Micrococcus, Pseudomonas, Clostridium* among. These isolates, members of genus *Aspergillus* were most prevalent (38%) followed by *Bacillus* comprising of 20% of the total microbial isolates. (Ashraf *et al*., 2007)

Fifteen mesophilic bacteria with high cellulase activities from a flower stalks-vegetable waste composing system. Study of morphological and physiological characters showed that to of them were closely related to *Bacillus* pasteurising and *Bacillus cereus*, whereas the rates belong to the genus *Halobacillus*, *Aeromicrobium* and *Brevibacterium.* (Lu *et al*., 2006)

At beginning of composting, mesophilic bacteria predominant but after the temperature increases to thermophilic bacteria take over in the compost. Thermophilic fungi are an essential biodegradation agent in the compost environment. (Ahmad *et al.,* 2007)

Enzymatic properties

Intracellular enzymes and external enzymes are two types of enzymes. Many fungi are capable of digesting extracellular cellulases, which depolymerize the cellulose substrate more effectively. Microbes can secrete a complex cellulase enzyme that can be used in the enzymatic hydrolysis of cellulose and the biodegradation of organic municipal solid waste. *Clostridium, Cellulomonas, Bacillus, Pseudomonas, Aspergillus,* and *Penicillium* are among the bacteria that decompose cellulose.(Gautam *et al*., 2012)

Proteases are enzymes that catalyse the hydrolysis of bonds in polypeptide chains, allowing them to be broken down into smaller polypeptides or free amino acids. Bacteria and their enzymes are converting wastes into useful biomass, and novel protease-producing microbes and better fermentation technology are needed to meet the ever-growing demand for these enzymes. *B.amyloliquifaciens, B.subtilis*, and *B.lichiniformis* are examples of protease-producing strains. *Staphylococcus, Pseudomonas, Serratia, Halobacterium*, and *Flavobacterium* are some of the most common bacteria. (Gupta and colleagues, 2005).

Amylase can be found in a variety of places, including plants, animals, and microorganisms. (Kathiresan & Manivannan, 2006) Amylolytic enzymes that degrade starch are essential in the biotechnology industry, with applications in food, fermentation, textiles, and paper. Janarthanan et al. (Janarthanan *et al*., 2014) 14^{th} distinct bacterial strains were isolated and identified, according to the report. When compared to the typical soil micro flora, *Bacillus spp*. and *Micrococcus spp*. (amylase generating bacteria) were identified as efficient starch hydrolysers and totally constituted the market waste in a short period of time.

Lipases are enzymes that hydrolyze lipids to produce fatty acids and glycerol. Bioremediation, medicines, food, agrochemicals, and biosurfactants are some of the applications of this method.

Microbial decomposition of organic waste

Biodegradation is the natural process by which wastes are recycled or organic matter is broken down into nutrients that can be used and reused by other organisms. Solid waste breakdown is aided by bacteria, fungus, and actinomycetes. The synthesis of intermediates or end products is accompanied by the breakdown of complex organic materials. (Anesio *et al.*, 2003)

Composting is a favoured and environmentally friendly method for converting organic waste to organic fertiliser and soil conditioners via biological processes (Gautam *et al*. 2010; Alexander 1999). Compost's high organic carbon content and biological activity make it ideal for uses like erosion control and revegetation (Anastasi *et al*. 2005). There are three stages to the composting process. Carbon dioxide levels rise in tandem with temperature during the first phase. Because of the breakdown of sugar and proteins by mesophilic organisms, the substrate is depleted (Zeng *et al.* 2011). The second phase sees the temperature in the compost piles rise from 45°C to around 70°C, with mesophiles being replaced by thermophiles (Pedro *et al.* 2003; Schloss *et al*. 2003). During this time, a large number of harmful people are degraded (Novinsak *et al.* 2008). The third step begins with the compost pile's temperature dropping.

Microbes need energy to carry out life functions by breaking down organic substances. The "heat" generated in composting is a by-product of biologic "burning," or aerobic oxidation of organic waste to carbon dioxide, which occurs under aerobic conditions. Aerobic organisms will dominate the compost pile and decompose the raw organic materials most efficiently if the right amounts of food (carbon), water, and air are available. (Cooperband, L. R. 2000)

Parameters affecting composting process

Temperature, moisture content, pH, and carbon/nitrogen ratio are all elements that influence the breakdown process. Composting will be more successful if the moisture content is between 55 and 65 percent (X. Wang *et al*., 2016) The moisture content range of 50-75 percent has a high moisture content and excellent activity of aerobic bacteria. Bacteria such as *Pseudomonas sp.*, *Bacillus sp*., and *Clostridium sp*., as well as a greater population of actinomycin, are typically found in aerobic soil (Alexander & Clark, 2016b)

The rate of decomposition can be determined by PH. In the degradation process, it determines the development rate and enzymatic potential of microorganisms. Due to the bio oxidation of the compost material, the pH rises from acidic to alkaline during the composting process. (X. Wang *et al.*, 2016)

The success of the degrading process is determined by temperature. Any change in temperature has an immediate impact on microbial activity. The higher the temperature, the more organic matter is degraded by the microbial activities. During the thermophilic stage, an increase in temperature kills pathogens present in raw materials (Huang, G. F *et al.*, 2004)

The carbon to nitrogen ratios in compost is the proportion of carbon to nitrogen in the material. It is an important composting measure since it indicates the compost quality. When the carbon/nitrogen ratio is between 30-40%, composting may be more successful**.**

Significance of decomposed waste

Biodegradation breaks down organic waste into relatively stable compounds that can be used as soil amendments or organic fertilisers. Living microorganisms are typically found in biofertilizers, and their actions help to improve soil ecosystems and produce plant-supplementing substances. Microorganisms and nutrients can be found in raw materials, which can aid improve soil health (Svensson *et al.*, 2004)

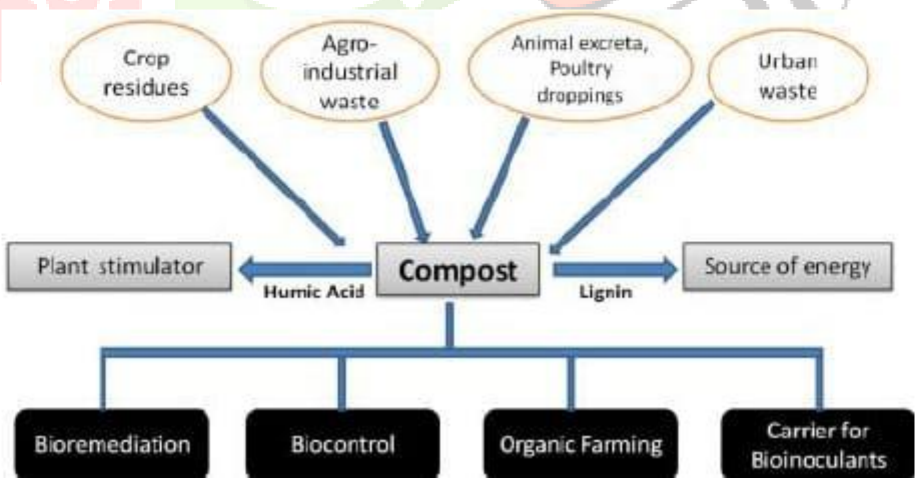

Figure: 1 Multifarious uses of the compost (Singh and Nain, 2017)

Conclusion

A large number of micro-organism was found in municipal solid waste, compost, and soil. Municipal solid waste is suitable for composting because of the presence of high percentage of organic matter. The T.viride had promising effects in the decomposition of organic municipal solid waste, resulting in the greater bioconversion of the original material then the control. Therefore, pH and temperature were considered as a good indicator for the end of the bioconversion of municipal solid waste in which the composts achieves some degree of maturity

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