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A STUDY ON EFFICIENT MICROORGANISMS ISOLATED FOR DEGRADATION FROM MUNICIPAL SOLID WASTE OF CHHATRAPATI SAMBHAJINAGAR, MAHARASHTRA, INDIA

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ABSTRACT

With rapid industrial development and the progress of civilization, the problem of increased waste generation has become more complex in urban areas. This research evaluates the composition and characteristics of municipal solid Waste produced in a representative residential neighbourhood. Ten samples were taken from the disposal site of the Chhatrapati—Sambhajinagar (Aurangabad) city area. Gathered from garbage, nine bacterial isolates were made using a nutrient agar medium. Investigations were conducted into the best culture conditions, microbiological traits, biochemical traits within the strains, tolerance to five heavy metals (Cadmium, zinc, Arsenic, lead and mercury), sensitivity to four different antibiotics (penicillin, streptomycin, oxytetracycline, and gentamycin), and extracellular enzyme production of the microbial strains. All six strains that could produce protease were used for the waste degradation efficiency test. Due to these findings, there is now a greater chance of identifying bacteria of scientific significance from municipal waste disposal sites, and these isolates may be a key source of compounds with practical applications in industry. Based on the research, it is possible to extract beneficial bacteria for the environmentally friendly bioconversion of solid Waste from the (Chhatrapati. Sambhajinagar (Aurangabad) city area.

INTRODUCTION

Solid Waste is defined as waste type that includes principally household waste/domestic Waste, with sometimes the addition of commercial Waste collected by a municipality within a given area. They are generally in either solid or semisolid form. Exclude industrial hazardous wastes. Solid Waste Microflora is the collective name for microorganisms living in solid Waste (SWM). Fungi and bacteria are the most prevalent organisms typically found in solid Waste. The waste materials serve as a growth substrate for these microorganisms. They develop and increase this Waste using the many solid waste elements. Furthermore, it has been found that these organic wastes contain a wide range of harmful microbes. The study of microflora has yet to be conducted in this field. So, we are interested in investigating the Bacteria present in solid wastes and their applications. Since the beginning of humankind, Waste has been generated in the form of bones and other parts of animals they slaughter for their food or the wood they cut to make their carts; with the progress of civilization, waste generation has become more complex.

Waste disposal threatens cooperation between man, animals and the soil. Like chemical hazards, aetiologic agents might be dispersed in the environment through water and wind. Poisonous plants, insects, animals and indigenous pathogens

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are biological hazards that might be encountered at the waste site (Khupe, 1996; Chetan et al., 2017). Solid Waste Microflora is the collective name for microorganisms living in solid Waste (SWM). Fungi and bacteria are the most prevalent organisms typically found in solid Waste. The waste materials serve as a growth substrate for these microorganisms. Using the many elements that comprise solid Waste, they develop and increase this Waste.

Furthermore, it has been found that these organic wastes contain a wide range of harmful microbes (Amalra et al., 2006). There was no significant study of microflora. So, we are interested in investigating the microorganisms present in solid wastes and their applications. The solid waste disposal industry divides solid Waste into four major categories for disposal depending on the state in which they are disposed of. The Waste produced in urban areas is generally known as municipal solid Waste (M.S.W.). 28.8% of India's population resides in urban areas (census 2011). It is predicted that 41% of the population will reside in cities by 2011. In India, waste quantity increased from 46 million tons in 2001 to 65 million tons in 2011 (Kumar & Gaikwad, 2011)—solid Waste in Chhatrapati. Sambhajinagar (Aurangabad) generates large amounts of poorly disposed and untreated Waste, so there is an urgent need to design scientifically unified solid waste management for the town. Earlier studies showed that people in urban areas produce half a kilogram, 10% of being burned. The average solid waste generation rate in low-income states or cities is only 0.4 to 0.6 kg/person/day, compared to 0.7 to 1.8 kg/person/day in fully commercial states (Cointreau, 1982; Blight & Mbande, 1996). Every day, massive amounts of waste materials are generated in all cities and municipal areas of India. Solid Waste in urban areas has a very high organic content, ranging from 70% to 85%.

India's urban solid trash generation is increasing with the country's population growth and per capita G.D.P.—the only municipality in Chhatrapati. Sambhajinagar (Aurangabad), which has a population of 10.07 million and an area of 325 square kilometres, believes that 3000 tons of Waste are generated daily by the A.M.C. In the Chhatrapati. Sambhajinagar (Aurangabad) city area, the daily rubbish generation per capita ranges from 0.35 kg to 0.4 kg. The formal system efficiently collects all garbage generated. A formal system recycles about 10%–15% of Waste, but illegal or self-disposable discarded uncollected Waste makes up 35–50% (Joerger et al., 2009). Therefore, this biodegradable fraction could be combined or co-composted as biofertilizers and soil conditioners (Parr & Hornick, 1992). The five main microorganisms in soils are actinomycetes, bacteria, fungi, algae, and protozoa. Bacteria make up the majority and are crucial for the breakdown of Waste (Sultana, 1997). Bacteria utilize Waste for their metabolism, and as a result, they create a few straightforward yet helpful mixes crucial for plant growth, soil health, and maintaining the overall equilibrium of a natural ecosystem. Composting involves the regulated breakdown or conversion of organic matter, typically in the presence of oxygen, into a stable, soil-like substance known as manure. The quantity of microorganisms, in addition to rodents and insects, is essential for the decomposition of solid Waste. Since bacteria are the most significant, it is possible to use efficient microorganisms to aid in solid organic Waste's breakdown. This study was conducted considering the critical importance of garbage decomposition to create a repeatable procedure and search for more active decomposer bacteria that could efficiently and effectively break down organic wastes and provide valuable components for plant nutrition (Sultana, 1997; Zaved et al., 2008; Chetan et al., 2017).

MATERIALS AND METHODS

Study Area: Chhatrapati. Sambhajinagar (Aurangabad) is an A-grade municipal corporation and the capital of Marathwada located at N19°53'47"–E75°23'54" of Maharashtra state. The city is bounded by mountains in all directions, titled "The City of Gates", and the strong presence of these can be felt as one drive through the city. Chhatrapati. Sambhajinagar (Aurangabad) is Maharashtra's tourism capital [and the fifth] largest city in Maharashtra. It has an average rainfall of 756.6 mm, and the maximum and minimum temperatures of the town are 42.6^0C and 9.1^0C, respectively. Temperature and wetness during the rainy season lead to a higher humidity content in municipal solid Waste, which raises the weight of the trash. Furthermore, heat and high humidity accelerate the breakdown of the organic waste component, creating challenges for processing and disposal that have an immediate negative impact on the residents' and garbage workers' environmental health.

Sample Collection: Ten waste samples were collected; five came from the Chhatrapati. Sambhajinagar (Aurangabad) Municipality's garbage transfer facility and the other five came from the city's industrial zone and landfill in Naregaon. Blended soil and garbage were evaluated, collected aseptically, stored at 40°C, and stamped as per their source and location as needed. Microbe samples were brought to the laboratory for soil isolation, and pH and moisture content were noted. In nutrient agar, all the microorganism cultures were kept at 40C. Every culture was subcultured every fifteen days. S_1: Solid Waste collected from Housing colony A.M.C. Area; S_2: Solid Waste from dumping (Garbage, behind Ghati Hospital) area at Chhatrapati. Sambhajinagar (Aurangabad) City Area Dump; S_3: Soil surface, Salim Ali lakeside of Delhi Gate, Chhatrapati. Sambhajinagar (Aurangabad); S_4: Transportation of Solid Waste in AMC Area Wet soil, drain side of Naregaon Area Chhatrapati. Sambhajinagar (Aurangabad); S_5: Solid Waste Dump Sites in A.M.C. Area drain side garbage, Chhatrapati. Sambhajinagar (Aurangabad); S_6: Soil surface, Segregation of Waste and Recycled items in A.M.C. Area, Chhatrapati. Sambhajinagar (Aurangabad); S_7: Waste Encroached Road in Chikalthana Industrial Area wet soil of drain. S_8:Waluj Industrial Area Housing Colony Waste Dumping Sites in wet soil of drain. S_9: Garbage, Chitegaon area, Chhatrapati. Sambhajinagar (Aurangabad) and S_{10}: Refuse, slaughterhouse, Padegaon Area, Chhatrapati. Sambhajinagar (Aurangabad). Three bacterial samples, S1 through S3, had superior growth on their ideal Medium. These three samples were labelled as S3, S2, and S1, respectively, since I.U.L. was observed on Nutrient Agar media (N.A.), Dump was observed on Basic Czapek-Dox-Agar medium (BCDA), and S1 was observed on Basic Czapek-Dox-Agar medium (BCDA). Previous research teams have noted this unappealing pattern in the literature (Bundela et al., 2010; Chatterjee, 2010; Thorat & Chavan, 2021). Residential areas should not be too close to waste disposal sites, and covered rubbish bins are a good idea. Waste disposal plants are sporadically located near the A.M.C. area's residential areas

and public buildings. A typical view of these types of trash disposal sites can be found at the Naregaon site, which is in one of the government-reserved zones of Chhatrapati. Sambhajinagar (Aurangabad) Municipal Council area (AMC).

Characteristics of Waste: The following parameters of the synthetic normal for the test were broken down: organic matter (%), absolute N (%), P(%), and K(%). Following a quick titration technique, natural carbon was resolved Agarwal 2005. The trash was processed using a combination of acids ($HClO_4$, HNO_3, and H_2SO_4) to determine the aggregate nitrogen content. This was done using the Kjeldahl methodology, as demonstrated by the method presented by Agarwal 2005. A colourimetric approach was used to evaluate all the phosphorus using stannous chloride and ammonium molybdate. The Flame photometric approach was used to measure absolute potassium.

Pure Culture: A solitary colony was detected and subsequently re-streaked onto the surface of a nutrient agar plate along with Basic Czapek-dox agar (BCDA) medium as the major inoculant. After that, the plates were incubated at either room temperature or 30°C. Pure cultures were examined using nutrient agar plates and Basic Czapek-dox agar (BCDA). Gramme dye was chosen to confirm that the cell morphology and gram reaction were identical to the original colony's. At this stage, pure cultures were again examined using the previously described procedures, and a new nutrient agar plate and Basic Czapek-dox agar (BCDA) were re-streaked with the appropriate colony. Once a pure culture was obtained, the same colony was streaked onto a BCDA slant and nutrient agar. These cultures were refrigerated for a full day of incubation. The isolates from the soil were used for further experiments.

Biochemical Tests: The catalase test detects soil bacteria; 2-3 ml of the hydrogen peroxide solution was poured into a test tube. Using a sterile wooden stick, several colonies of the test organisms were removed from the nutrient agar plate and Basic Czapek-dox agar (BCDA) medium and immersed in the hydrogen peroxidesolution. Bubble formation was then observed. Lactose and mannitol fermentation differentiate the microorganisms fermenting carbohydrates such as lactose andmannitol. Voges Proskauer test was carried out to detect the production of acetylmethylcarbinol acetoin, a natural product formed from pyruvicacid during glucose fermentation. The buffered glucose broth and the organism were inoculated and incubated at 37^0C for three days. Approximately 3 ml of alpha naphthol was added, followed by 1 ml of 40 % K.O.H. and mixed well for 30 minutes. For the result, the pink solutionmeans V.P. (+) and no change means V.P. (-).

Isolation of Microorganisms: Municipal sludge and sewage were the sources of the soil samples. These germs were isolated using serial dilution and streaking methods until a single colony was obtained. Twenty agar plates were prepared aseptically. After the agar plate was ready, the fast-growing bacteria plate was taken. The bacteria on the plate are chosen based on the different shapes. The selective bacteria on the agar plate are streaked using an aseptic technique. The plate is divided into four parts. The streak agar plate is sealed and kept in a 30°C incubator for growth. After 24 hours, the bacteria was purified by another spread plate technique and incubation. Besides that, gram staining was done on the previous plate. Samples were observed under a microscope and characterized based on Chetan et al. (2017).

Biochemical tests were performed to identify microorganisms using a standard procedure based on Bergey's manual. Numerous biochemical identification techniques were employed to identify these bacteria from municipal sludge, including the Gramme stain, spore formation, strict anaerobes, starch hydrolysis, Voges-Proskauer, and swollen cell test. Municipal sludge can be identified biochemically using various techniques, including the Gram stain, starch hydrolysis, citrate test, and Voges-Proskauer. A urease test was used to detect soil bacteria; a dense "milky" suspension of the test organism was prepared in 0.25ml physiological saline in a small tube. A urease tablet was added into the tube and incubated at 35-37^0C for up to 4h or overnight. The color change was observed in the test organism. An indole test was done to detect the soil bacteria. The culture contained tryptophan for the development of test organisms. This Medium was prepared in a bijou bottle with 3 ml of sterile tryptone water. The Medium was then added with 0.5 ml Kovac's reagent (4p-dimethylamino-benzaldehyde) with gentle shaking, and thecolour was observed. The ability of an organism to use citrate as a carbon source and ammonia as a nitrogen source is known as the Citrate utilization test. The media will turn green to blue if the citrate utilization test is positive.

RESULTS AND DISCUSSIONS

This study involved isolating and characterizing bacterial strains from various locations within the Chhatrapati—Sambhajinagar (Aurangabad) Municipality area and from industrial zones. Numerous physiochemical factors affect bacterial growth, including Medium, pH, temperature, incubation time, carbon source, etc. Bacteria can grow in a wide range of moisture levels. The current investigation began with the discovery that the moisture content of the samples obtained ranged from 25.09 to 78.19%. The samples from S3 and S2 had the highest moisture content (78.19%), while those from S1 had the lowest moisture content (25.09%). The relationship between a soil's bacterial population and moisture content is well-established. Themaximum bacterial density is found in regions of high moisture content, and the optimum level for the activities of aerobic bacteria is often 60 to 70 % of the soil's moisture-holding capacity (Sonawane et al., 2010). Most aerobic soils include large numbers of Achromobacter, Pseudomonas, and Bacillus species; anaerobic and damp environments favor the growth of Clostridium. Under such circumstances, actinomycetes are proven to a comparable reckonable growth (Sonawane et al., 2010) observed using a variety of growth media, including potato dextrose agar (P.D.A.), nutrient agar (N.A.), and Czapek-Dox agar (both acidic and basic), the investigation's isolated strains were seen to develop. Nutrient agar (N.A.) medium was found to be fitting for the massive growth of the S3 strain in Table 2, whereas basic Czapek-Dox-agar (BCDA) was found to be suitable for the

massive growth of the S1 and S2 strains in Table 1.

Table 1. Effect of different pH on the growth of isolated strains in BCDA[a] medium

pH of Medium	Strains	Incubation Period					
		6 h	12 h	24 h	36 h	48 h	72 h
7.1	S1	NG	PG	GG	GG	GG	**GG**
	S2	NG	PG	GG	GG	GG	**GG**
	S3	NG	PG	MG	GG	GG	**GG**
7.6	S1	NG	PG	GG	GG	GG	**GG**
	S2	NG	PG	GG	GG	GG	**GG**
	S3	NG	NG	PG	MG	GG	**GG**
9.1	S1	NG	NG	PG	PG	MG	**MG**
	S2	NG	NG	PG	PG	PG	**PG**
	S3	NG	NG	NG	NG	PG	**MG**
10.6	S1	NG	NG	NG	NG	NG	**NG**
	S2	NG	NG	NG	NG	NG	**NG**
	S3	NG	NG	NG	NG	NG	**NG**
12.10	S1	NG	NG	NG	NG	NG	**NG**
	S2	NG	NG	NG	NG	NG	**NG**
	S3	**NG**	**NG**	**NG**	**NG**	**NG**	**NG**

[a]BCDA = Basic Czapek-Dox-Agar; NG = No growth; PG = Poor growth; MG = Moderate growth; GG = Good growth.

Table 2. Effect of different pH on the growth of isolated strains in NA[a] medium

pH of Medium	Strains	Incubation period					
		6 h	12 h	24 h	36 h	48 h	72 h
4.2	S1	NG	NG	NG	NG	NG	**NG**
	S2	NG	NG	NG	NG	NG	**NG**
	S3	NG	NG	NG	NG	NG	**NG**
5.7	S1	NG	NG	NG	NG	PG	**PG**
	S2	NG	NG	NG	NG	PG	**PG**
	S3	NG	NG	NG	NG	PG	**PG**
7.2	S1	NG	PG	MG	MG	GG	**GG**
	S2	NG	PG	MG	MG	GG	**GG**
	S3	NG	PG	MG	GG	GG	**GG**
8.7	S1	NG	NG	MG	MG	MG	**MG**
	S2	NG	NG	PG	PG	MG	**MG**
	S3	NG	NG	PG	MG	MG	**GG**
10.2	S1	NG	NG	NG	PG	PG	**PG**
	S2	NG	NG	NG	PG	PG	**PG**
	S3	**NG**	**NG**	**NG**	**PG**	**PG**	**PG**

[a]NA = Nutrient Agar; NG = No growth; PG = Poor growth; MG = Moderate growth; GG = Goodgrowth.

It was discovered that the pH range of the two media was 7-8. Bacterial strains grew most readily in N.A. and BCDA at pH 7.2 and 7.6, respectively. Based on the previously mentioned data, the pH values of the S2, S1, and S3 strain samples were 7.79, 7.95, and 7.86. This could be the cause of the bacteria's successful in vitro growth at pH 7-8 in BCDA and N.A. Although bacteria can react with soil at pH values ranging from 4 to 10, most prefer a pH somewhat on the alkaline side of neutrality. Certain Bacillus spp. can thrive at pH 11, but Thiobacillus thiooxidans and Acetobacter spp. can only grow at pH levels 0 and 2. Agarwal (2005). Thermo-actinomycetes can only develop at temperatures between 50°C and 65°C. Their optimal growth occurs at pH levels 8 or 9, while reactions at approximately five significantly inhibit their growth. (Amalraj, 2006). Mycobacterium tuberculosis var. grows well but slowly (2–6 weeks) at 37°C on glycerin agar or a solid medium such as coagulated egg, serum, or blood. Escherichia coli, Vibrio, and Streptococcus faecalis can also withstand an alkaline reaction (pH 8–9) (Amalraj, 2006). Three strains of bacteria were used in this experiment, and their cultures were cultured at various temperatures—25, 29, 34, 37, and 40°C. 37°C was the temperature at which all strains grew massively. For bacteria, the ideal temperature range is between 25 and 36°C. The temperature range of 10-40°C is suitable for the growth of many microorganisms. Sultana (1997) noted that the optimal temperature range for bacterial growth was 33–40°C. Some bacteria grow most quickly at temperatures lower than 200 degrees Celsius. Some thermophiles can multiply below 40°C, and thermophiles often grow at temperatures between 45 and 65°C 2010 saw (Sonawane et al., 2010). While M. Chelonei and M. Marinum grow well at lower temperatures (18–30°C), Mycobacterium avium thrives best at 40°C. On tomato juice agar, Lactobacillus sp. grows best at 25 to 39°C. On standard laboratory media, Agrobacterium sp. grows well at pH of 6.8 to 25 and 39°C (Sultana, 1997). At around 25°C, streptococcus lactis can be grown on agar plates with milk, whey, tomato juice, or sterile milk. It grows most readily when lactose or glucose is present. Around 35°C is better for growing than 25°C (Amalraj, 2006). The strains used in this investigation underwent varying lengths of incubation (6, 12, 24, 36, 48, and 72 hours). The S1 and S2 strains grew well with a 24-hour incubation period. However, the S3 strain required a 36-hour incubation period. Coliform bacteria grow in the incubation period of 24±2 h and at 32°C, and they show good growthat 37^0C for 48h of incubation. Three methods were used to characterize the selected strains: non-microscopic or visual observation, microscopic observation, and biochemical tests.Upon visual inspection, it was

discovered that following a 24-hour incubation period, S1 had turned pale orange, S2 had turned white, and S3 had turned light brown in their chosen media (BCDA and N.A.). Following a 48–72-hour incubation period, S1 turned orange, S2 turned yellow, and S3 turned brown. While S3 had a creamy colony type, the S1 and S2 strains had wet colonies. Staphylococci and Micrococci develop golden brown, yellow, or white colonies on regular media. Certain enterococci, coryneform, and enterobacteria can form black colonies on a regular medium. According to Chatterjee (2010), Staphylococcus aureus produces glossy, convex, black colonies on the Baird-Parker medium. An established and trustworthy technique for observing microorganisms is gram staining—alcohol-decolored gram-negative bacteria, causing them to lose their crystal violet-purple hue. According to Uwadiegu and Iyi (2014), gram-positive bacteria did not decolourize and continued to be purple. Every isolated strain found in the current study tested positive for gram-positive bacteria. Because the isolated strains (S1, S2, and S3) produced oxygen gas from hydrogen peroxide (H_2O_2) through enzymatic degradation, they all showed positive catalase test results. A similar result was observed in Zurbrugg (2002). Several biochemical tests have been performed to study the characteristics of bacterial strains, as shown in Table 3. A fermentation test differentiates the microorganisms that ferment carbohydrates, such as lactose and mannitol. The isolated strains exhibited positive lactose and mannitol fermentation tests because open and sealed tubes produced a yellow color.

In the urease test, due to red and pink color formation through the media, the S2 strain showed a positive urease test, which could decompose urea to ammonia. S1 and S3 showed negative tests because they did not produce a red-pink color in this Medium. The indole test demonstrates the ability of certain bacteria to split the amino acid tryptophan into indole, which accumulates in the Medium. The S3 strain showed a positive test and produced a red color in the media. S2 and S1 strains showed negative tests because they did not produce a red color in the media (Butu & Mshelia, 2014). They also observed the same result. S2 and S3 strains showed positive results in the hydrogen sulphite production test because they produced black color in the media. However, S1 displayed a negative test as this strain did not produce a black color in the media. Sultana (1997) observed the same result. The citrate utilization test was based on an organism's ability to use citrate as its only carbon source and ammonia as its only nitrogen source. The S3 strain showed a positive citrate utilization test because the Medium turned green to blue. S1 and S2 did not turn the media blue; therefore, they showed negative tests, as shown in Table 4.

Numerous researchers conducted studies demonstrating how domestic waste decomposition accumulated and separated lower volatile fatty acids and volatile organic compounds (V.O.C.s) (Sonawane et al., 2010). The weight and volume of the stuff diminish as bacteria break down the Waste. Because of the bacteria that broke down the Waste and transformed it into simple molecules, we also saw a decrease in the weight and volume of the treated rubbish in the current breakdown study. After 30 days of treatment with S2 strain, the maximum weight loss in suspension treatment for the breakdown of solid Waste without additives was observed at 50.70%. Chatterjee (2010) initiated the highest weight loss (26.06 %) using *the Trichoderma* strain after 30 days in a similar study.

Table 3. Biochemical tests of some waste-decomposing bacteria

Strains	Catalase	Lactose Fermentation Test	Mannitol Fermentation Test	Voges-Proskauer Test	Urease Test	Indole Test	Citrate Utilization Test	Identified Bacteria
S3	+ve	+ve	+ve	-ve	-ve /+ve	-ve /+ve	+ve	***Xanthomonas* spp.**
S2	+ve	+ve	+ve	+ve	+ve	-ve	-ve	***Bacillus* spp.**
S1	**+ve**	**+ve**	**+ve**	**+ve**	**-ve**	**-ve**	**-ve**	***Pseudomonas* spp.**

Table 4. Changes in temperature during garbage decomposition by bacterial suspension and different concentrations of molasse solution at 3-day intervals.

Days	Temperature (°C) of decomposition garbage by treating B.C. Dump strain and molasses solution.				Temperature (°C) of Decomposition garbage by treating SL and molasses solution				Temperature (°C) of decomposition garbage by treating S3 strain and molasses solution			
	5% MS[a]	10% MS[a]	15% MS[a]	C.T. [b]	5% MS[a]	10% MS[a]	15% MS[a]	C.T. [b]	5% MS[a]	10% MS[a]	15% MS[a]	CT [b]
3	29	29	29	29	29	29	29	29	29	29	29	**29**
6	31	31	32	29	31	31	31	29	31	31	31	**29**
9	33	33	34	30	33	33	33	30	32	32	33	**30**
12	35	35	36	30	34	35	35	30	33	33	34	**30**
15	37	37	39	30	36	37	37	31	35	35	36	**31**
18	37	38	40	31	36	37	38	31	35	36	37	**31**
21	35	38	40	31	34	35	37	31	33	34	36	**31**
24	33	36	37	31	32	34	35	31	31	32	34	**31**
27	**32**	**34**	**34**	**30**	**31**	**32**	**33**	**30**	**30**	**31**	**31**	**30**

[a] M.S., Molasses solution, [b] C.T., Control.

After 30 days, the highest volume loss for the S2 strain in suspension treatment was 38.67%, and in pellet treatment, it was 36.73%.

Additives such as sucrose can be used with garbage for decomposition, increasing the growth of bacteria (Mohapatra, 2006). It was observed that by treating with sucrose solution, the growth of bacteria was high, and the decomposition rate was also high. It added sucrose solution to the garbage and enhanced the decomposition rate through

increasing fermentation. After 30 days of inoculation, the S2 strain showed the most significant percentages of weight loss (52.73%, 55.32%, and 65.12%, respectively) in the 5%, 10%, and 15% sucrose solution treatment (together with the bacterial strain). Of all those treatments, the S2 strain with a 15% sucrose solution had the most significant weight loss at 65.12%. A similar pattern for volume loss was discovered. With a 30% sucrose solution added and 30 days of inoculation, the S2 strain showed the most significant volume loss (51.34%). Thus, regarding weight reduction and volume loss, S2 and a 15% sucrose solution were the most effective strains for sucrose treatment. Since sucrose treatment successfully facilitated trash decomposition, molasses was eventually employed as a less expensive and alternative source of carbohydrates to aid in the breakdown of solid Waste. Following a 30-day inoculation, the S2 strain showed the highest weight loss percentages of 56.70%, 62.70%, and 80.24% in the 5%, 10%, and 15% molasses solution treatments, respectively. Of all those treatments, the S2 strain's 15% molasses solution resulted in the most significant weight loss, at 80.24%. A similar pattern for volume losses was discovered. After 30 days of inoculation with the S2 strain and 15% molasses solution, the most significant volume loss was discovered to be 64.27% (both in terms of weight loss and volume loss). Again, comparing the effect between different concentrations of sucrose and molasses treatment for degradation of solid Waste with bacterial suspension, the highest weight loss was 80.24 % in the 15 % molasses solution in the S2 strain.

In contrast, the 15% sucrose solution in S2 resulted in the most significant weight loss, 65.12%. A similar pattern for volume losses was discovered. Thus, the waste breakdown method using 15% molasses was the most successful regarding volume losses, followed by a 15% sucrose solution. On the other hand, bacterial suspension without any additives reduced volume change more than treatments including additives. The maximum volume loss (%) in the 15% sucrose treatment was 51.34% after 30 days of inoculation in the S2 strain; the highest volume loss (%) in the 15% molasses solution was 64.27%. A related investigation (Ramesh & Mathivanan, 2009) discovered that Trichoderma strains with 4% glucose concentrations lost 66% of their body weight. After two weeks of composting, the ultimate weight of the dead and after-birth piglets in the composting pile was just 3.1 kg (6.9 lb), according to (Zaved et al., 2008). The remaining tissue easily crumbled in the sawdust medium. Over 6% of the initial animal mass was lost on average per day in this experiment. The current study found that molasses treatment outperformed sucrose treatment regarding volume loss (%) and weight loss (%) when breaking down organic solid Waste with bacterial suspension. It can be explained in this way that in molasses, some extra components (which were absent in sucrose) could give extra nutrients to the rapid growth of bacteria and increase the number of bacterium cells. So, the degradation process with molasses solution was higher with more bacteria than with sucrose solution treatment. So, the growth of bacterial strains was the main factor in decomposing garbage.

The relationship between volume loss and weight loss was linear, and no interaction was found between the two parameters. Both volume loss (%) and weight loss (%) increased gradually with the progression of the decomposition process, and the result was the same for each strain treatment. The weight loss (%) was higher than volume loss (%) in garbage decomposition in each strain treatment, as shown in Figure 1.

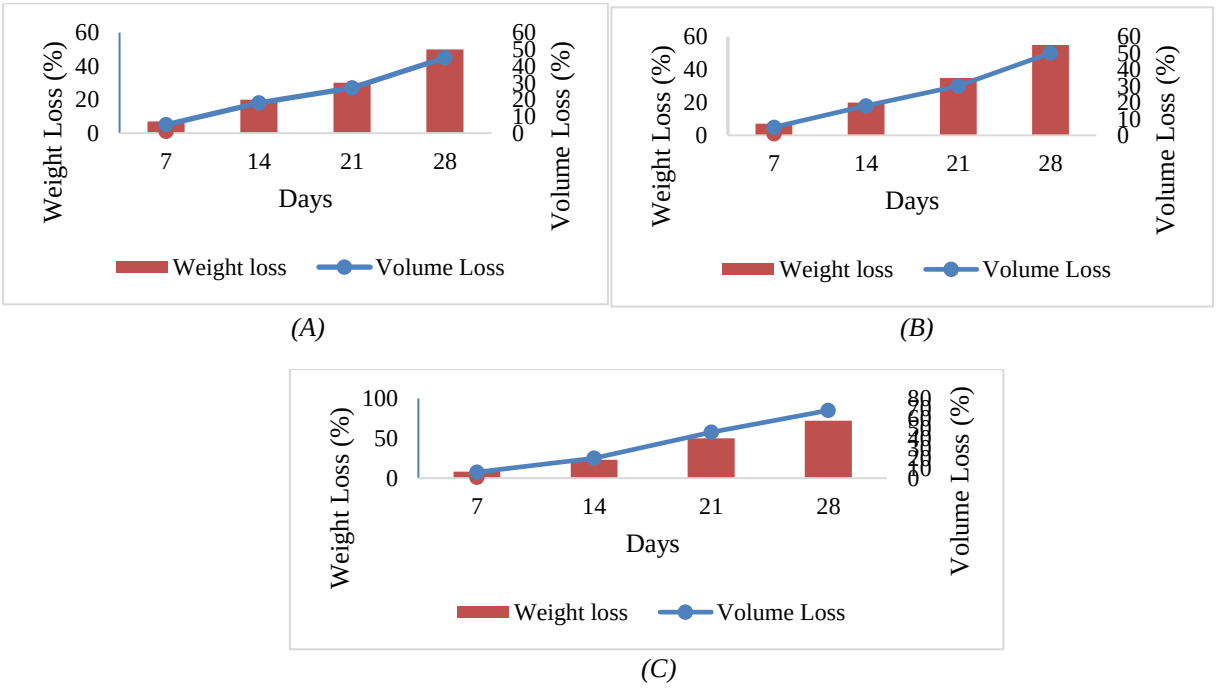

Figure 1. Weight loss (%) and volume loss (%) of decomposed garbage at 7-day intervals using S2 suspension and different concentrations of molasses solution. (A) S2 + 5% molasses solution; (B) S2 +10% molasses solution; (C) S2 +15% molasses solution.

According to Ezeah and Roberts (2012) and Bundela et al. (2010), heat is produced, and the temperature rises when bacteria break down garbage. In this investigation, we found that the temperature grew steadily in all cases after 4-6 days, peaked after 15–24 days, gradually decreased after 28–30 days, and finally decreased to its starting point. Designed for decompositionin the composting method of solid Waste *in vitro* conditions by bacterial suspension and culture pellet, the highest temperature was 37°C after 15-18 days in suspension treatment of S2 andS1 (Figures 2 and 3).

Figure 1(A)x

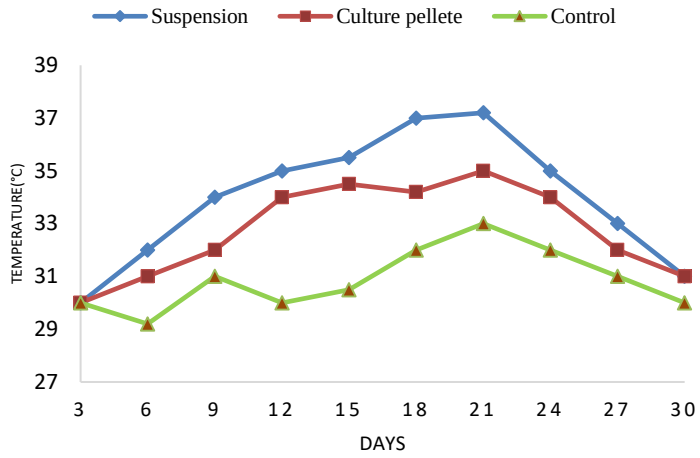

Figure 1(A)

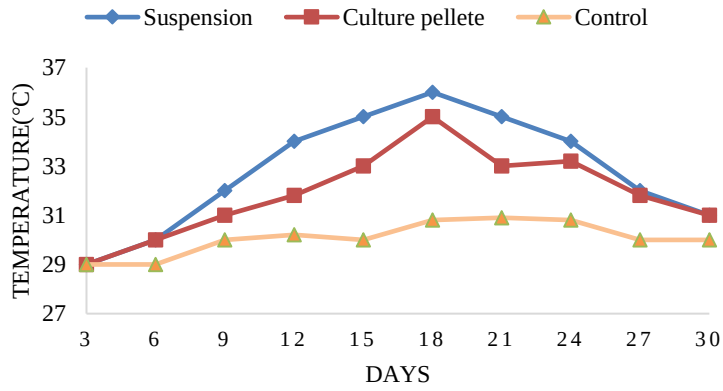

Figure 1(B)

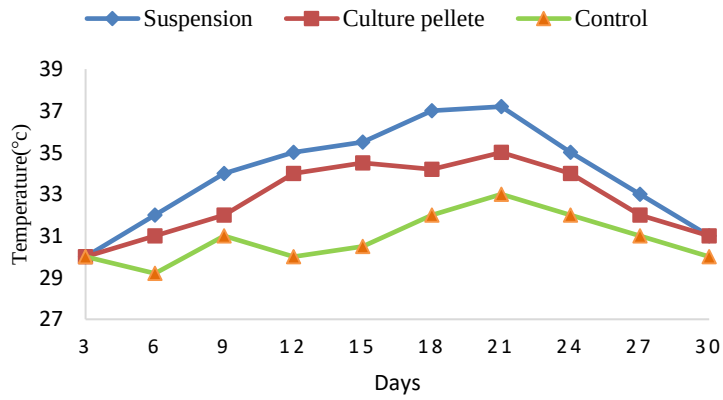

Figure 1(C)

Figure 2. Changes of temperature (°C) during garbage decomposition at 3-day intervals using suspension and culture pellet of the three strains: (A), S2 strain; (B), S1 strain; (C),S3 strain.

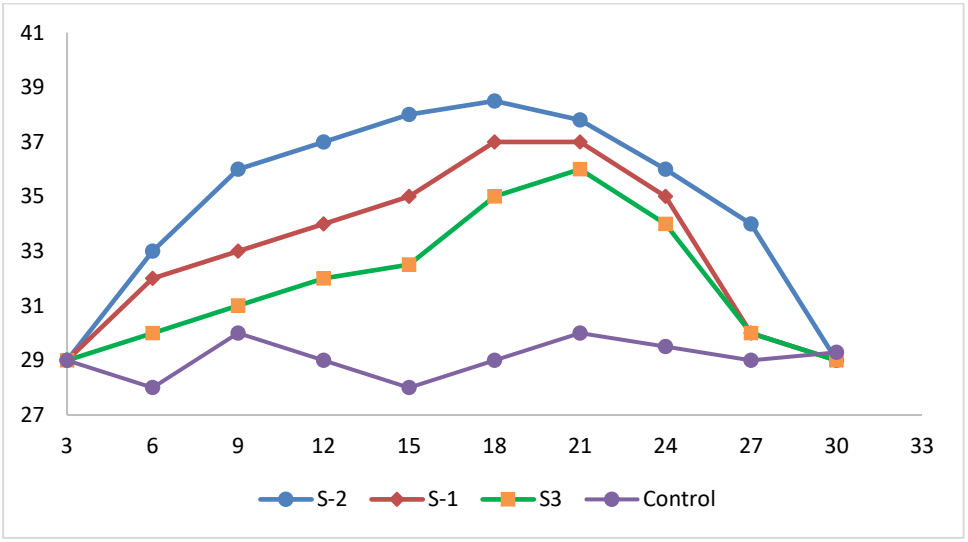

Figure 2(A)

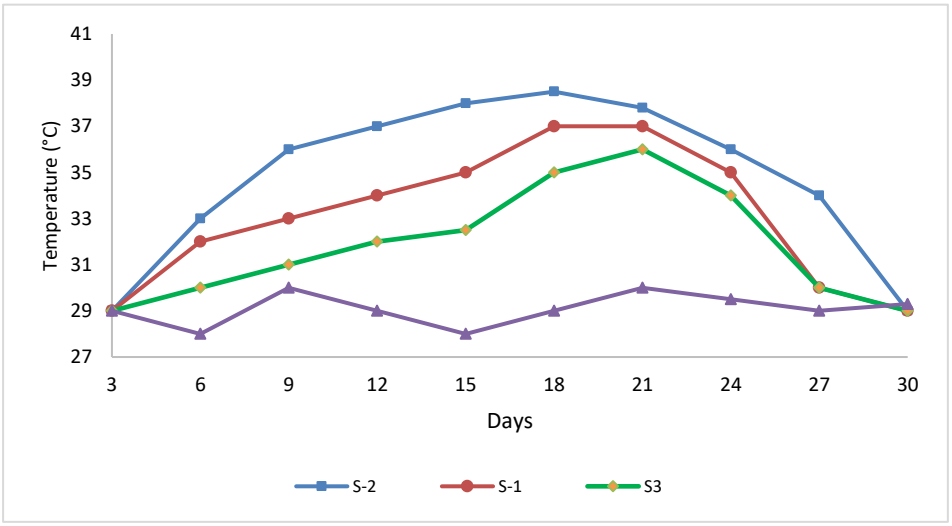

Figure 2(B)

Figure 3. Changes of temperature (°C) during garbage decomposition at three-day intervals using thethree strains separately, along with the most effective concentration of additives. (A), three strains + 15% sucrose solution; (B) Three strains + 15% molasses solution.

The maximum temperature reached by the S2 strain with 15% sucrose solution after 18 days was 39°C. After 18 days, the maximum temperature for the molasses solution, which included 15% molasses solution in the S2 strain, was 40°C. Thus, it may be concluded that a high decomposition rate may be related to temperature. This study's treatment with the highest temperature had the most significant weight and volume loss. The S2 strain had the most weight and volume loss in all instances, along with a high temperature. The original pH of the fresh rubbish used in this experiment was 4.11, which is acidic. The pH of degraded Waste in suspension and pellet treatments and treatments with sucrose and molasses changed from an acidic to an alkaline condition in all cases. The pH ranged from 7.31 to 11.06. The S2 strain-decomposed 15% molasses solution yielded the highest pH of 11.06.

When bacteria are grown in a medium with a pH of 7, it is quite probable that this pH will alter due to substances the organism produces, which could be primary or acidic (Thorat & Chavan, 2021). It has been noted that as composting progresses, the pH changes over time. Most bacteria thrive in the pH range of 6.0 to 7.5. For the remaining composting, use 7.5 to 8.5. Composting produces organic acids at the first stage. The pH value lowers in the first few days for this acidic state. However, after a few days, the temperature rises, and the pH value rises as more organic Waste decomposes. After 10, 20, and 30 days, an unpleasant smell was associated with the bacterial culture pellet decomposition of organic kitchen waste, suggesting a slow degradation of organic materials. After ten days, there was a pungent stench in the solid waste decomposition process caused by bacterial suspension. After 30 days, there was no stench, suggesting that the organic kitchen wastes had possibly wholly degraded. In a related study, Ahsan (1999) found that composting reduced the odour during the breakdown of solid Waste. According to the study, beneficial bacteria may be separated from the surrounding environment to favourably facilitate the bioconversion of solid organic Waste. This study demonstrates how valuable and successful the established method of waste

decomposition is in safeguarding human health and the environment from waste-related issues. The study was conducted to see the effect of fresh, decomposed garbage and bacterial suspensions on biomass production on a fresh-weight basis of potato *Solanum tuberosum*. For the experiment, decomposed garbage using bacterial suspension and15 % molasses, fresh garbage, and bacterial suspensions were used separately in the soil pot of potato.

A control treatment using simple garden soil was carried out for every treatment. The highest biomass output (65.61 g) was obtained in the decomposed garbage treatment, broken down by S2 suspension and 15% molasses. In contrast, fresh garbage and bacterial suspension showed 50.98 and 39.31 g of biomass production, respectively. The maximum biomass output (58.41 g) was shown by the decomposed garbage treatment, which was broken down by S1 suspension and 15% molasses; fresh garbage and bacterial suspension showed 48.45 and 37.07 g of biomass production, respectively. The highest biomass output (52.18 g) was obtained in the decomposed garbage treatment, broken down by 15% molasses and S3 suspension.

In contrast, fresh garbage and bacterial suspension produced 47.69 and 34.19 g of biomass, respectively. In all cases, the addition of decomposed garbage to soil enhanced biomass production when compared with fresh garbage or bacterial suspension treatment. With decomposed Waste and a 15% molasses solution, S2 suspension produced the most biomass in terms of fresh weight, followed by S1 and S3. Fresh trash and bacterial suspension outperformed the control: garden soil alone.

CONCLUSIONS

Solid Waste contains different microorganisms. Furthermore, it is concluded that several drug-resistant organisms are found in solid Waste and garbage in Chhatrapati—Sambhajinagar (Aurangabad) city and industrial areas, which spread bacterial diseases. Hence, solid Waste should be segregated and purified before being sent for recycling. Because civil solid Waste is a blend of many substrates, it is an ideal advancement medium for the growth of different microorganisms. Our current research shows that a metropolitan trash dump may serve as a breeding ground for various mechanical and antimicrobial microorganisms.

Furthermore, it can be a valuable tool for bio-searching new or rare species, which may produce important bioactive particles essential for environmentally harmful trash contamination. In combination, it can also serve as a respectable adjunct in the industrial sector. In contrast to other natural conditions, the metabolically dynamic nature of the microbes in this environment produces various catalysts and bioactive mixtures. Therefore, it is crucial to understand the Waste implied by tiny creatures from a biological perspective and how they might benefit environmental biotechnology.

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Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

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Conflicts of Interest: The authors declare no conflict of interest.

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