MICRO ENVIRONER
https://doi.org/10.54458/mev.v3i04.00028

Micro Environer
ISSN No - 2783-3526

RESEARCH ARTICLE

Eco-friendly Approach for the Degradation of Food Waste

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Received: 06th October, 2024; Revised: 07th November, 2024; Accepted: 05th December, 2024; Available Online: 17th December, 2024

ABSTRACT

Food waste is a serious problem globally. The management of food waste requires solutions on an urgent basis. The use of chemicals is costly, time-consuming, and causes pollution. The study here involves the degradation of food waste, viz., hotel, kitchen, and hostel areas, using *Bacillus*, *Alcaligenes*, and *Streptomyces* sp. and a consortium of these microorganisms. The reduction in weight and volume was calculated for the degradation of food waste. There was about 45% reduction in the weight and volume of the food waste without any foul smell. Using microorganisms to degrade food waste is simple, cheap, and eco-friendly.

Keywords: Consortium, Eco-friendly, Environment, Manure, Sustainable

Micro Environer (2024); DOI: 10.54458/mev.v3i04.00028

How to cite this article: Author Name, Title. Micro Environer. 2024;3(4):1-3.

Source of support: Nil.

Conflict of interest: None

INTRODUCTION

Food waste is a serious problem worldwide, so managing food waste is the immediate need of the hour [1]. In India, about 68,760,163 metric tons of food are wasted annually [2]. The use of chemicals for the degradation of food waste has many disadvantages. The food waste is lignocellulosic, containing cellulose, hemicellulose, and lignin [3]. The microorganisms can degrade and convert the complex form into a simple format. The organisms can contaminate the food waste and convert it into value-added products. Minimizing food waste will help in many ways, and there will be no food shortage; hence, this study will be necessary.

MATERIALS AND METHODS

Isolation of bacteria degrading food waste

The soil samples were collected from three different locations viz., Morwadi, Nehru Nagar, and Bhosari, Pune, Maharashtra. The serial dilution was performed, and 0.1 ml was spread on nutrient agar (N.A.) media [N.A. (g/lit): peptone - 10, yeast extract - 3, NaCl - 5, pH - 7.2, agar - 30, distilled water - 1000 ml] and the plates were incubated in the incubator at 37 ºC for 24 hr. The single colony was streaked on N.A. plates, and then the isolates were maintained on N.A. slants for further studies.

Characterization and identification of the isolates

The morphological characters, enzymes viz., oxidase [4 and catalase production [5] and biochemical tests viz., citrate utilization [6], hydrogen sulfide (H_2S) production [7], and sugar fermentation (glucose, lactose, galactose, fructose, maltose, sucrose, and xylose) of the isolates were performed. This was compared with Bergey's Manual of Determinative Bacteriology (1992) [8]. The three selected isolates were used for the study of food degradation wastes.

Collection of food waste

The food waste (1 kg) was collected from the kitchen, hotel, and hostel areas (Fig. 1) in clean plastic bags.

Processing of the food waste

The collected food wastes were washed with tap water and dried in an oven for 24 hr at 100 C. Further, the food waste was packed in clear plastic bags and appropriately labeled.

Composition of the food waste

The composition of food waste was studied, viz., for the presence of carbohydrates, proteins, fats, and oil using the method of [9].

Preparation of inoculum for the food waste degradation studies

The nutrient broth (N.B.) (100 ml) was prepared, and *Bacillus*, *Alcaligenes*, and *Streptomyces* sp. were inoculated individually. Then, the consortium was also designed in a ratio of 1:1. All the flasks were kept on a rotary shaker at 37 C for 24 hr.

Food waste degradation studies

The clean trays (size 120 x 120 cm) were taken in which 100 g of heaps of each food waste was placed separately (Fig. 2).

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(a) (b) (c)

Figure 1: Food waste collected from (a) kitchen, (b) hotel, and (c) hostel

The inoculum of *Bacillus*, *Alcaligenes*, and *Streptomyces* sp. prepared was mixed (5%) with each food waste separately as well as the consortium prepared was mixed (5%) (Fig. 2). The control without any inoculation in food wastes was also kept. The initial weight and volume of the food waste were noted. The reduction in weight and volume was then calculated on days 7, 15, and 21, respectively. The volume was determined using the formula:

$V = \pi \times r^2 \times h$ [10] (Eq. 1),

Where V = volume of the heap

$\pi = 3.14$

r = radius of the heap

h = height of the heap

RESULTS AND DISCUSSION

Isolation, characterization, and identification of the isolates

The three isolates were chosen and labeled No. 1, 2, and 3, respectively. The isolates 1 and 3 were Gram-positive rods, while isolate 2 was Gram-negative. The isolates No. 1 and 2 were motile. All three isolates were positive for catalase production. The isolates No. 1 and 2 were positive for oxidase production. The isolate No. 1 showed the presence of endospore performed by the method of [11]. The isolates were found to be favorable for citrate utilization. None of the isolates showed H_2S production. All three isolates showed fermentation of glucose. The isolate No. 1 showed fermentation of galactose and xylose. All three isolates showed fermentation of fructose. The isolate No. 3 showed fermentation of lactose, maltose, and sucrose sugars. Compared with Bergey's Manual of Determinative Bacteriology, isolates 1, 2, and 3 were found to be *Bacillus*, *Alcaligenes*, and *Streptomyces* sp., respectively.

Degradation of food waste

The reduction in volume and weight of the food wastes, viz., hotel, kitchen, and hostel, is shown in Fig. 3 and Fig. 4, respectively, which indicates the degradation of these food wastes. This shows that *Bacillus*, *Alcaligenes*, and *Streptomyces* sp. can degrade food waste. The consortium of these organisms for the degradation of food wastes was also observed in our study. There is a report on biodegradation of food wastes by *Bacillus* sp. [12]. Bacteria, actinomycetes, and fungi have been reported for the degradation of kitchen waste by composting [13]. From Fig. 3 and 4, it is seen that on day 21, there is most reduction in volume and weight of the food wastes by *Bacillus*, *Alcaligenes*, and *Streptomyces*. The same result is seen when the consortium of these organisms is prepared. There are reports on various approaches to global reduction for waste reduction and cutting food loss [14].

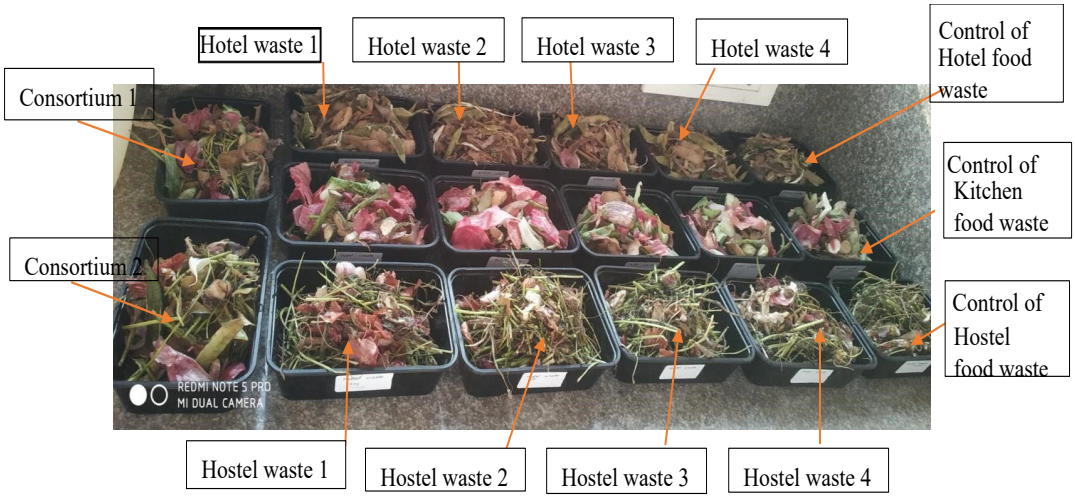

Figure 2: Food waste collected from (a) kitchen, (b) hotel, and (c) hostel

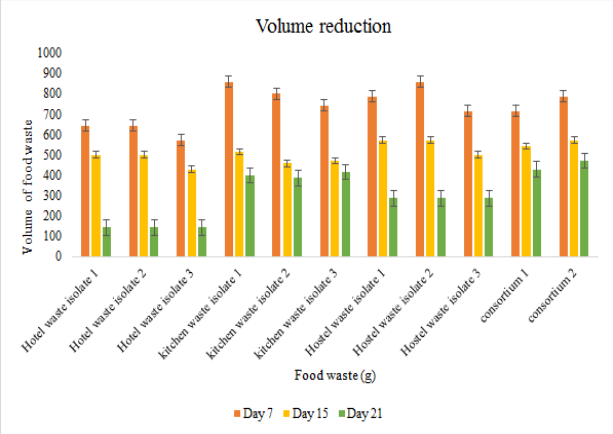

Figure 3: Reduction in volume of the food wastes

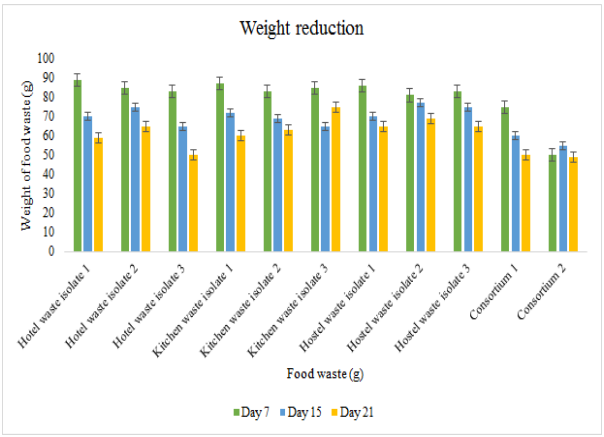

Figure 4: Reduction in weight of the food wastes

CONCLUSION

The biological approach to the degradation of food waste will be a straightforward, economical, and eco-friendly method. This simple solution will help in the proper management of food waste, which is the need of the hour.

ACKNOWLEDGEMENT

Not applicable.

GRANT SUPPORT DETAILS

The present research did not receive any financial support.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest regarding the publication of this manuscript. In addition, the ethical issues, including plagiarism, informed consent, misconduct, data fabrication and falsification, double publication and submission, and redundancy, have been ultimately observed by the authors.

LIFE SCIENCE REPORTING

No life science threat is practiced in this research.

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