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# Preliminary Studies on Time Saving and Low Cost Transformation of Garden Wastes (Leaf Litter and Weeds) through Fungal Biodegradation and Vermicomposting

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**Abstract**

A preliminary experiment was carried out to evaluate the impact of fungal isolate screened and identified as cellulose producer Rhizomucor towards decomposition of green wastes (leaf litter, grasses and weeds) and subsequent vermicompost development. The vermicompost developed through normal process was considered as control and compared with the experimental one for its physiochemical properties. Data recorded on primary decomposition, time period required for vermicompost development and nutrient content exhibited the superiority of fungal degraded green waste and subsequent vermicompost over normal control vermicompost.

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## Introduction

Management of green wastes from garden, local plantations and house hold droppings are quite difficult and requires huge energy as manpower and other functional machinery. To save energy, an alternative way is needed to improve the mechanical management of green waste. However, vermicomposting is useful process for rapid conversion of any organic wastes into growth promoting manure (Sequeria et al., 2015). Generally, the raw material is first primarily decomposed by using cow dung slurry and requires 60-90 days prior to be utilized for vermicomposting. The time taking process of primary decomposition of raw materials like leaf litter etc emphasize the need to explore the potentials of cellulolytic microbes for the transformation of green wastes into useful primary product. The microbial decomposition of waste materials will take less time. To this perspective, present study was carried out by using cellulose degrading fungi for degradation of green waste collected from garden and subsequent decomposition through vermicomposting. The objective was to save time and obtain product with high nutrient content. The detailed records on time period required to obtain the final product and its biochemical and mineral composition are presented in this article.

## Materials and methods

Cellulose degrading fungi from vermicompost and leaf litter were isolated, purified and screened for cellulase production in vitro conditions (Hart et al., 2002). All fungal isolates confirmed for cellulase production were evaluated for their potential of degradation of native substrate like grass, weeds and leaf liter in vitro conditions. For this experiment, simple native substrates (weeds, leaf litter, and grasses) were taken into the culture vessel of 250 ml capacity and moistened with sterilized water, autoclaved and inoculated with fresh growing culture of selected fungi. Simultaneously, uninoculated control was also incubated along with test flasks. Observation for the degradation (suppression of biomass) of native substrates was taken after 21 days of incubation at 30°c. The fungal strain showed maximum degradation of substrate was selected, identified and characterized prior to field evaluation. The slide culture method and microscopic analysis was followed for the morphological identification of fungi (Nagmani et al., 2013). Selected fungal culture was evaluated for its extracellular enzymes and metabolites (Amylase, Protease, Lipase, Cellulase, Xylanase, L-Asparaginase, organic acid, IAA production and P-solubilization). Selected fungal culture was characterized for its culture and growth requirement. The major factors for characterization and requirement of growth performance taken into consideration were pH, temperature, incubation, salt, chelating agent, heavy metals, etc.

Field experiment was set up in vermitank (width 125cm, Length 300cm and depth 50 cm). The submerged liquid culture of the selected fungi was prepared by inoculating in Sabouraud dextrose broth (250 ml conical flask containing 100ml of culture medium, pH 6.0) and incubated for three weeks at 30°C. The mass fungal culture (1600 ml) was supplemented in the tank which was mounded with green wastes up to 85 cm and watered alternate day with sprinkler. The reduction of biomass, texture and moisture retaining capacity in vermibed were recorded. Finally the myco-decomposed material (remained upto 21 cm) was shifted to a new tank (width 40cm, Length 100cm and depth 50cm) where earthworms (*Eudrilus eugeniae*) were added. The cow dung manure (100 g of diluted in 2 lt. of water) was sprinkle on the material only once (Manyuchi et al., 2014) (Raj et al., 2014). The vermicompost developed through naturally decomposed material (without fungal inoculations) was considered as control. Both types of vermicompost were analyzed for its physiochemical properties (Tandon, 1999).

## Results and discussion

All 47 fungal cultures were evaluated for cellulase and except few, remaining all was found to be producer of this enzyme in extracellular conditions. In vitro experiment with all positive fungal strains for cellulose production have shown the F 24 as most promising strain as it was degraded native substrate by 80 % within 21 days (Fig. 1). Among them F 24 was selected for the further characterization for its other useful extracellular activity. It was found that this fungus was organic acid producer, xylanase, phosphate, JNF positive, amylase and asparaginase producer. The fungal strain preferred Sabouraud, potato dextrose and fungi Kimming agar and malt extract. It preferred 5.8 pH, 30°C, and incubation period of 7 days. This fungus was identified as Rhizomucor through morphological characterization. The fungus was found to be tolerant of 1% NaCl and KCl. The growth of this fungus under different pH exhibited the wide range i.e., 4.5 to 7.5. Higher pH of the medium reduced the growth of the organism. The organism preferred dark condition for the growth but affected by the presence of presence of dye like methylene blue and cotton blue. However, bromophenol blue, phenol red, bromothymol blue and bromocresol green had less effect on its growth in liquid culture conditions.

*In vitro* biodegradation of native substrate have shown good response of Fungal strain. It was observed that this fungal strain degraded the grass material in vitro condition positively within 7 days (Fig. 1). The green material became blackish in color and smooth in texture. Uninoculated control remained same as for longer time. Among all 47 fungal strains tested, this fungal strain showed promising and exploitable results. Further, this strain was inoculated into the pots containing grass material under green house condition. The green material was degraded in 7 days, materials became fragile and the amount decreased. Normally, it takes two to three months prior to vermicomposting in large scale.

Experiment with the fungal inoculation on grass and other green waste in field condition under vermicompost units showed very promising results. The green waste degraded within 7 days, became fragile and decreased in volume upto 1/4. The primary decomposed material was treated with earthworms and observed for the vermicomposting. The normal degraded grass material was also treated for vermicomposting separately. The fungal treated green waste transformed into vermicompost within 45 days where as the control and untreated vermibed showed late vermicompost production and took 60-70 days. Whole process from natural green waste collection, primary decomposition and vermicompost formation takes 90-120 days where as fungal treated primary decomposition and vermicompost formation took 45-60 days in our experiment.

The physiochemical properties of the primary decomposed material and vermicompost are depicted in Table 1. Experimental vermicompost had very high level of moisture retaining properties (45%) as compared to normal vermicompost (7.14%). C:N was measured in the both types of vermicompost and it was comparatively higher in vermicompost developed through fungal treated green waste materials. Similarly, the amount of total P, K and Na was enhanced in experimental vermicompost where as the heavy metal content Fe, Mn, Cu were available in decreased amount as compared to the normal vermicompost. Over all, experimental vermicompost was nutritionally rich in terms of P and K content which is very important for the plant growth and development. The presence of heavy metal content is not promising for the plant growth. However, it was less in case of experimental vermicompost.

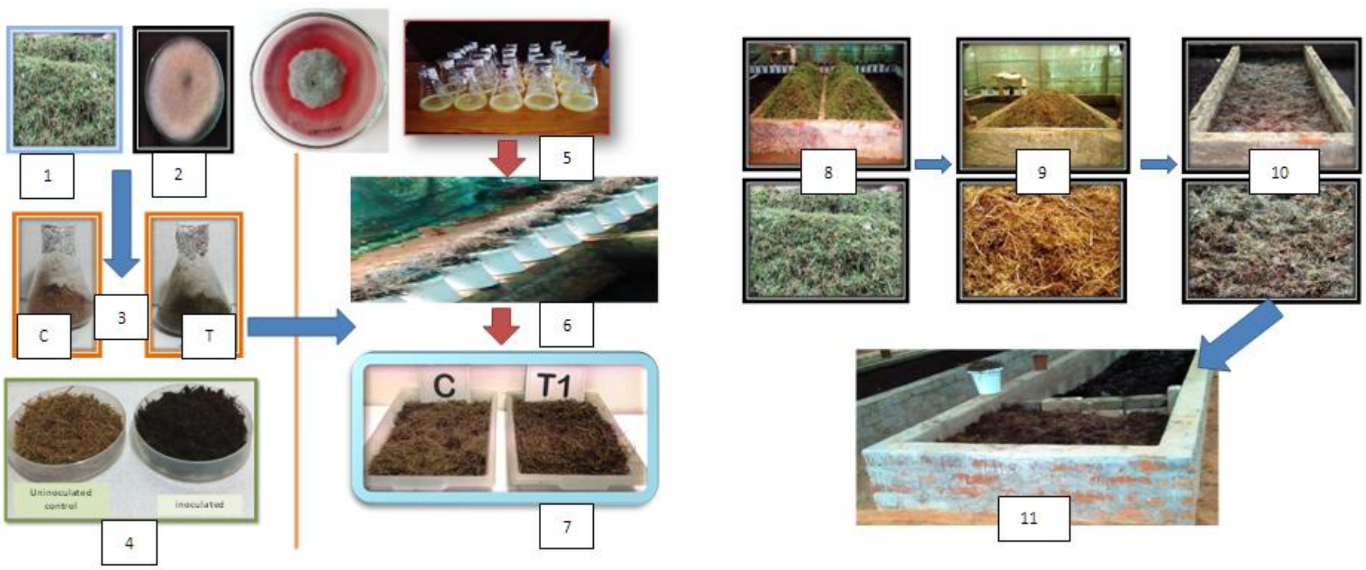


**Fig. 1:** Experimental Process of primary decomposition and subsequent vermicomposting through fungal degradation (1) green weeds, (2) fungal culture, (3) degradation in culture flask control C and Test T, (4) comparison of fungal inoculated and uninoculated degraded material, (5) Mass culture of fungus, (6) fungal treatment in poly pots, (7) comparison of degraded material, (8) Experiment in large scale green material, (9) dried material (normal), (10) fungal degraded material and (11) transfer of fungal degraded material in vermitank and vermicomposting.

**Table 1.** Physiochemical properties of vermicompost developed through normal process and experimental conditions.

| S. No. | Parameters | Normal vermicompost | Experimental vermicompost |
|---|---|---|---|
| 1 | Moisture (%) | 7.14 | 45.00 |
| 2 | OC (%) | 7.46 | 10.00 |
| 3 | Total N (%) | 0.18 | 0.18 |
| 4 | Total P (%) | 0.16 | 0.43 |
| 5 | Total K (%) | 0.26 | 0.64 |
| 6 | Total Ca (%) | 5.20 | 2.18 |
| 7 | Na (%) | 0.062 | 0.15 |
| 8 | Fe ($mg/kg^{-1}$) | 7061.00 | 2497.00 |
| 9 | Mn ($mg/kg^{-1}$) | 457.00 | 431.00 |
| 10 | Cu ($mg/kg^{-1}$) | 3.80 | 1.70 |
| 11 | Zn ($mg/kg^{-1}$) | 14.60 | 14.00 |

Seven different types of vegetable had been taken into consideration to test the growth promoting potential of prepared vermicompst and compared with the normal vermicompost usually prepared with the cow dung decomposing and further vermicomposting by earthworms. It was found that the experimental vermicompst was proved to be better than the normal one as the seeds of vegetable germinated early in case of ladies finger, beans, trigonella and coriander. Not only the plant development, it was observed that the positive effect of experimental vermicompost on leaf number, no. of fruits in case of ladies finger and beans. The plants of coriander and trigonella produced more biomass as compared to the normal vermicompost.

Studies conducted on screening of cellulolytic fungi and its evaluation for the primary decomposing as well as vermicomposting exhibited very promising results and confirmed the cellulolytic potential of one of the fungal strains fruitful in this endeavor. Findings on the biodegradation of green wastes through fungal activity and subsequent vermicomposting through *Eudrilus eugeniae* a night crawler earthworm proved to better option towards time cut back of the long process usually required for the vermicomposting in normal way.

Not only the time saving, this experiment with selected fungi and its role in preparation of decomposed material required for the better and early vermicomposting come out with the good quality of compost as pot experiment on experimental vermicompost exhibited growth promoting properties better than the normal vermicompost. More experimentation at laboratory and field scale is required to reach any conclusion pertaining to the exploitable potential of the fungi in mass scale.

## Conflict of interest statement

Authors declare that they have no conflict of interest.

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