



## Original Research Article

# Degradation of biomedical waste including plastic waste by fungus periconiella species

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## ABSTRACT

**Introduction and Objective:** Myriad of health care institutes and hospitals are producing a huge quantity of biomedical waste. The existing methods of biomedical waste treatment and management are quite expensive requiring remarkable power consumption and high temperature. Moreover, they liberate many deleterious toxic byproducts, endangering the health of residents in the vicinity. This present study utilizes the help of the mystical, saprophytic, Coprophilic fungus *Periconiella* sp. for degradation of biomedical waste including plastic waste.

**Materials and Methods:** The coprophilous fungus *Periconiella* sp. was cultivated in culture plates by using Indian Deshi cows dung incubated at room temperature. On appearance of the growth, the *Periconiella* fungus was subcultured on Sabouraud Dextrose Agar (SDA) containing Chloramphenicol and Cycloheximide to prevent bacterial contamination. Before sub-culturing, the fungus *Periconiella* was confirmed morphologically based on 10% potassium hydroxide (KOH), Lacto phenol cotton blue (LCB) preparation and slide culture. The utility of fungus *Periconiella* sp. was tested for degradation of biomedical waste containing soiled cotton, gauze pieces, dressing material, surgically removed tissue pieces and plastic waste.

**Observation and Result:** The cultivated fungus *Periconiella* sp. Was found to be coprophilic and saprophytic. The cultivated fungus from each culture plate could completely degrade 25g of biomedical waste comprised of soiled cotton, gauze pieces, dressing material, surgically removed tissue pieces and plastic waste in a span of 18 to 40 days.

**Interpretation and Conclusion:** A mystical, novel, saprophytic Coprophilic fungus *Periconiella* sp. from Indian Deshi cow's dung is observed to be a better degrader of biomedical waste mass containing soiled cotton, gauze pieces, dressing material, surgically removed pieces and plastic waste within a period of 40 days. Moreover it is economical, less demanding and eco-friendly method for biomedical waste disposal including plastic waste.

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## 1. Introduction

A huge quantity of hazardous biomedical waste is produced by artillery of old and new health care organizations, imposing a tremendous stress and load on the disposal system for its treatment and management.<sup>1</sup> Presently practiced biomedical waste disposal methods inherit the danger of health hazards, environmental pollution and

occupational hazards. Commonly used method of incineration is effective but, is responsible for many health and environmental hazards, as it generates dioxins, furans in the smoke and flyash.<sup>2</sup> Dioxins and furans lead to development of neurological ailments among children, reproductive problems in women and increase the risk of skin cancer in the residents of nearby locality. It also liberates sulfur dioxide that may lead to various respiratory and cardiac problems.<sup>3</sup> A eco – friendly plasma pyrolysis

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technology needs very high temperature and power consumption making it beyond the reach of developing countries. Hydroclaving and Microwaving also do not seem feasible in the context of poor resource nations.<sup>4–6</sup> Though fungus *Aspergillus* sp. can degrade soiled cotton but, it causes health hazards. The cattle dung is known to produce biodegradable fungus.<sup>7,8</sup> The saprophytic, coprophilic fungus *Periconiella* sp. cultivated from Indian Deshi cow's dung was tested for its role in degradation of biomedical waste including plastic waste.

## 2. Materials and Methods

We obtained dung sample from 50 buffaloes, jersey cows and Indian Deshi cows. The dung from cattle were moistened and incubated at room temperature in glass culture plates for the cultivation of saprophytic, Coprophilic fungus *Periconiella* sp. The growth appeared over the culture plates containing Indian Deshi cow dung within 15 days but there was no growth on culture plates containing buffalo and jersey cow dungs. The colonies on Indian deshi cow dung had entire margin with compact aerial mycelium. The colonies were raised and velvety exhibiting brown pigment on obverse. Fungal elements were tithed with needle and KOH, LCB preparations were studied under microscope.

### 2.1. KOH preparation

Revealed fungal elements composed of septate hyphae with wide angled branching, blastospores and double walled hyaline fungal cells.

### 2.2. LCB preparation

Showed hyaline, septate, creeping hyphae with wide angled branching and a globus ascus containing ascospores.

### 2.3. Culture on Sabouraud Dextrose Agar (SDA) with Chloramphenicol and Cycloheximide (to prevent bacterial growth)

From Indian Deshi cow dungs culture plates, the fungus *Periconiella* sp. was subcultured on SDA and was incubated at 30°C. It revealed luxuriant growth on SDA after 48 hours. The colonies were having entire margin containing compact velvety, greenish to grayish aerial mycelium. Obverse showed formation of brown pigment. The colony character also exhibited presence of hyaline, verrucose and thin walled submerged hyphae.

### 2.4. Slide culture

Revealed monomorphic conidiophores with fewer branches. Hyphae were septate showing branching. Creeping hyphae showed coconut tree like appearance due to presence

of vertically arising conidiophores. It also exhibited an obvious ascus bearing ascospores. The saprophyte was confirmed by morphological study, various staining methods and biochemical tests. Thus the isolated fungus was confirmed to be pure culture of *Periconiella* sp. belonging to Ascomycota.

### 2.5. Method for biodegradation

A total of 25 g of biomedical waste and plastic waste (5g soiled cotton + 5 g soiled gauze pieces + 5g soiled dressing + 5g surgically removed tissue pieces + 5 g plastic waste pieces) was placed separately in lumps over the pure culture of fungus *Periconiella* sp. obtained on SDA.

Institutional ethical clearance was obtained for the proposed project.

## 3. Observations and Results

Biomedical waste spread on the pure culture of fungus *Periconiella* sp. obtained on SDA showed claws from the fungal growth surrounding the biomedical waste mass. It was observed that the decomposition and degradation of soiled cotton, gauze pieces and dressing material were started on the 4<sup>th</sup> day, whereas the dissolution of the surgically removed tissue pieces began from 7<sup>th</sup> day and the degradation of plastic waste decomposition initiated from 9<sup>th</sup> day.

The process of decomposition was observed and recorded on daily basis. On our observation we noted that the applied 25gm biomedical waste mass in separate lumps were completely decomposed within 40 days.

To have a control, the same amount of biomedical waste mass comprised of above material was kept on the pure culture of fungus *Aspergillus* sp, *Fusarium* sp. and *Mucor* sp.

In control experiment, *Aspergillus* sp. could degrade soiled cotton only taking 55 days, while *Fusarium*, *Mucor* did not show any effect concerning degradation of biomedical waste mass.

## 4. Discussion

Majority of the hospitals install incinerators for rapid treatment, management and disposal of biomedical waste generated in their hospitals. Many other health care organizations outsource disposal of their biomedical waste to the agencies. Many of these incinerators are of substandard quality, not complying with the working provisions in the biomedical waste (Management and Handling) Rules, thereby betraying the objective of incineration of biomedical waste material as laid down by Central Pollution Control Board in Delhi and other states (Biswas D 2001).<sup>2</sup>

Though incineration is a very effective method for disposal of biomedical waste but, it is expensive. Moreover

**Table 1:** Showing biodegradation of biomedical waste by a variety of fungal species

| S. No. | Name of the fungus | Types of solid biomedical waste in grams |                     |                          |                        |                         |
|--------|--------------------|--|---------------------|--------------------------|------------------------|-------------------------|
|        |                    | Soiled Cotton                            | Soiled gauze pieces | Soiled dressing material | Surgical tissue pieces | Plastic material pieces |
|        |                    | 5g                                       | 5g                  | 5g                       | 5g                     | 5g                      |
| 1      | Aspergillus sp.    | 55 days                                  | No effect           | No effect                | No effect              | No effect               |
| 2      | Fusarium sp.       | No effect                                | No effect           | No effect                | No effect              | No effect               |
| 3      | Mucor sp.          | No effect                                | No effect           | No effect                | No effect              | No effect               |
| 4      | Periconiella sp.   | 22 days                                  | 28 days             | 38 days                  | 18 days                | 40 days                 |

**Fig. 1:** Culture of periconiella on cow dung**Fig. 3:** Surgical tissue pieces degraded**Fig. 2:** Soiled cotton degraded**Fig. 4:** Biodegradation of plastic pieces

it is inherited with many environmental and health hazards including liberation of dioxins and furans in the smoke and flyash. They can lead to development of neurological disorders in pediatric age group; ailments related to reproductive system in women and increases the risk of skin cancer in the residents of nearby locality. Sulfur dioxide liberated through incinerators cause various respiratory as

well as cardiac problems. Each hospital should design its own policy for biomedical waste management based on its set up. All clinical pathology, microbiology laboratories and blood banks have to abide by the rules and regulations of Biomedical Waste Management 1998 (Ministry of Environment and Forests Notification).<sup>2</sup>

The cost is another factor influencing proper disposal of biomedical waste. The infectious and noninfectious waste must be segregated and put in color coded bags.

Considering the above factors of environmental hazards, health hazards and economy, the present study of biomedical waste degradation by fungus *Periconiella* sp. is promising. This method has low health risk and is eco-friendly, less expensive which can be implemented with bare minimum setups. Also it can degrade plastic waste without polluting environment. The degradative enzymes produced by this fungus need to be evaluated.<sup>9,10</sup>

## 5. Conclusion

A mystical, novel, saprophytic Coprophilic fungus *Periconiella* sp. from Indian Deshi cow's dung is observed to be a better degrader of biomedical waste mass containing soiled cotton, gauze pieces, dressing material, surgically removed pieces and plastic waste. Moreover it is economical, less demanding and eco-friendly method for biomedical waste disposal including plastic waste.

## 6. Source of funding

None.

## 7. Conflict of interest

None, as all the authors had contributed equally for isolation, observation, results, analysis and preparation of manuscript.

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