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BIOCOMPOSTING TECHNOLOGY AND MICROBIAL POPULATIONS OF AGROINDUSTRIAL WASTE USING *PLEUROTUS SAJOR-CAJU* AND EARTHWORM (*EUDRILUS EUGENIAE*)

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ABSTRACT

Agro-waste can be considered as an important source for biocomposting technology as it contains more nutrients compared to other organic wastes. Biocompost has significant quantities of macro and micro-nutrients and beneficial microorganism. Corncob and coir pith are major agro-industrial wastes in India which decompose very slowly due to the presence of high amount of lignin, cellulose and hemi-cellulose components. The present study was aimed to analyze changes in the microbial population during the composting of corncob and coir pith. Six kinds of composting experiments were carried out by using corncob and coir pith. Microbial population was studied at regular intervals of 0-30, 30-60 and 60-90 days in the composting unit C_1, C_2, C_3, C_4, C_5 and C_6 during the composting period. The present study concluded that combined application of coir pith, *Pleurotus sajor-caju* and *Eudrilus eugeniae* - treated compost (C_6) is microbiologically more active than other worm un-treated substrates.

KEY WORDS: **Compost *Pleurotus sajor-caju, Eudrilus eugeniae,* corncob and coir pith.**

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INTRODUCTION

Every year, human beings, livestock and crops produce approximately 38 billion metric tons of organic wastes in the developed and developing countries[1]. The disposal of organic wastes plays an important role for a healthy environment. The safe disposal and environmentally friendly management of these wastes have become a global priority. In India, the amount of waste generated per capita is estimated to increase at a rate of 1–1.33 tons annually[2]. Recycling of agro-wastes is one way of disposal mechanism and another way of resource management. Corncob and coir pith are major agro-industrial wastes in India. The major components of corncob and coir pith are cellulose, lignin and hemi-cellulose and are degraded more scientifically using *Pleurotus sajor-caju* and *Eudrilus eugeniae*[3]. Earthworms are well-known natural machineries. They can transform organic waste materials into vermicompost that is useful for agriculture application. Earthworms live in close relationship with soil microorganisms. The alimentary canal itself possesses more number of bacteria and fungi. The earthworm promotes microbial activity during the decomposition of organic matter[4]. The present study was aimed to find out the changes by assessing microbial colony forming units of bacteria and fungi in selected agro-industrial wastes during the process of composting.

MATERIALS AND METHODS

Collection of Agro-industrial wastes

The agro-industrial wastes corncob and coir pith collected in large amounts from Tamil Nadu Agricultural University, Coimbatore, were chopped into small pieces, dried under sun light and stored in gunny bags.

Compost pit preparation

Six composting pits each measuring 1.5 feet length and 4 square feet width and named as C_1, C_2, C_3, C_4, C_5 and C_6 (C stands for compost)

Corncob compost process

The corncob waste was subjected to decomposition by various ways to achieve good quality biocompost.

Compost 1

The sundried corncob waste was transferred to C_1 pit, spread with 20 g of *Pleurotus sajor-caju* spawn uniformly and sandwiched above with a layer of one kg of corncob waste. This process was repeated till the heap reaches a height of above 1 m.

Compost 2

C_2 pit was filled with corncob and was allowed for decomposition for 30 days. Vermicomposting process was adopted.

Compost 3

C_3 pit was filled by corncob. It was predigested by using *Pleurotus sajor-caju* spawn. Vermicomposting process was adopted.

Coir pith compost preparation

Above-mentioned procedure was repeated. Instead of corncob (C_1, C_2 and C_3), coir pith was used in the C_4, C_5 and C_6, respectively.

Experimental tray preparation using earthworm - Eudrilus eugeniae

After pre-decomposition, predigested material was transferred to the plastic trays, each measuring (50×35×15 cm), C_2, C_3, C_5 and C_6 and 15 exotic earthworms (*Eudrilus eugeniae*) were inoculated into each tray. Water was sprayed twice a day regularly to maintain moisture content. These experimental units were kept undisturbed under shade place for 60 days. After composting, the samples were taken and sieved as per the standard procedure on 90th day.

Composting units

C- Absolute control
Compost-1 (Raw corncob composted by using *Pleurotus sajor-caju* (5 t ha^{-1})
Compost-2 (Predigested raw corncob + *Eudrilus eugeniae* (5 t ha^{-1})
Compost-3 (Raw corncob predigested by using *Pleurotus sajor-caju* and *Eudrilus eugeniae* (5 t ha^{-1})
Compost-4 (Raw coir pith composted by using *Pleurotus sajor-caju* (5 t ha^{-1})
Compost-5 (Predigested raw coir pith + *Eudrilus eugeniae* (5 t ha^{-1})
Compost-6 (Raw coir pith predigested by using *Pleurotus sajor-caju* and *Eudrilus eugeniae* (5 t ha^{-1}).

Enumeration of Bacteria and Fungi

One gram of each sample was taken in sterile conical flasks containing 9ml of distilled water, shaken for 30 min in vortox mixer and used as stock from which various dilutions were prepared ranging from 10^1 to 10^7 with sterile distilled water[5]. One ml each of the dilutions of 10^6 (bacteria) and 10^4 (fungi) from each sample was transferred to sterile petri plates containing nutrient agar medium (bacteria) and potato dextrose agar medium (fungi) and incubated for one day and three days, respectively. Microbial colonies were counted during the decomposition of corncob and coir pith agro-industrial waste at regular interval of 0-30, 30-60 and 60-90 days. Viable colony count was done with the help of colony counter.

STATISTICAL ANALYSIS

The data obtained on 0-30, 30-60 and 60-90 days were analyzed statistically using two way anova and inference was drawn on the basis of results.

RESULTS AND DISCUSSION

The experimental results pertaining to the changes of microbial populations during biocomposting of corncob and coir pith agro-industrial waste were shown (Figs.1 and 2).

Bacterial population

On the 0-30th day, total bacterial count was increased in C_6 (4.01×10^6) and C_3 (3.78×10^6), followed by C_4 (3.59×10^6) compared to Control (1.31×10^6). On the 30-60th day, remarkable bacterial count was obtained in C_6 (8.02×10^6), followed by C_3 (7.84×10^6) and C_5 (7.65×10^6) compared to Control (2.38×10^6). During 60-90th day experiment, bacterial population was slightly decreased. Maximum bacterial population was observed in C_6 (7.09×10^6) and C_3 (6.90×10^6), followed by C_5 (6.20×10^6) over Control (1.68×10^6). (Figure 3, 4, 5)

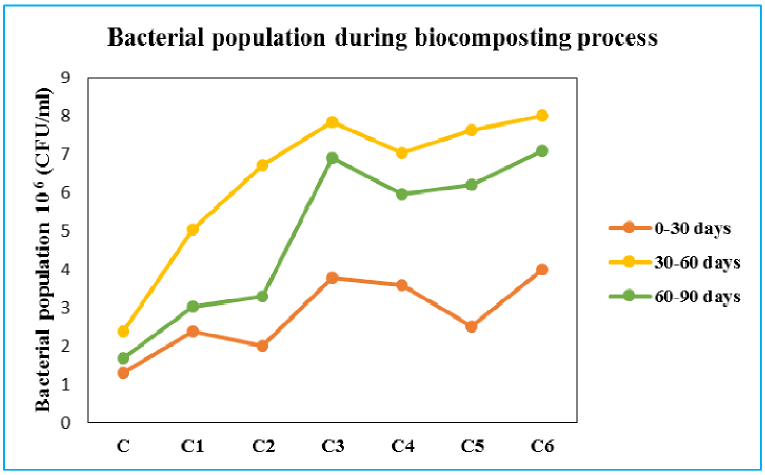


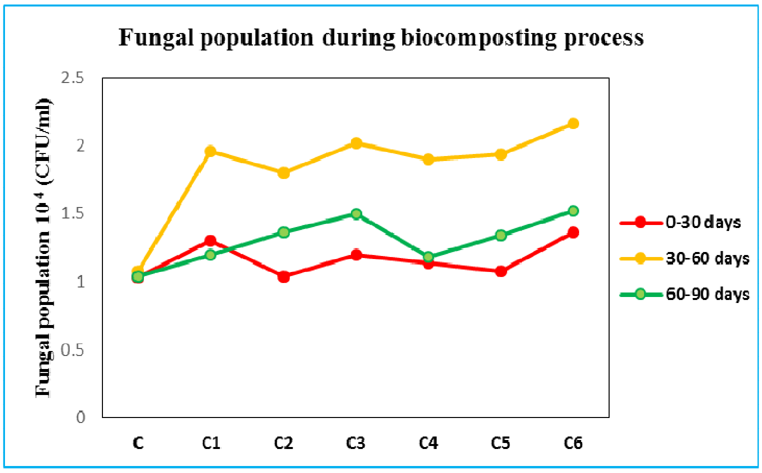
Figure1

C- Control
Compost-1 (Raw corncob composted by using *Pleurotus sajor-caju* (5 t ha^{-1})
Compost-2 (Predigested raw corncob + *Eudrilus eugeniae* (5 t ha^{-1})
Compost-3 (Raw corncob predigested by using *Pleurotus sajor-caju* and *Eudrilus eugeniae* (5 t ha^{-1})
Compost-4 (Raw coir pith composted by using *Pleurotus sajor-caju* (5 t ha^{-1})
Compost-5 (Predigested raw coir pith + *Eudrilus eugeniae* (5 t ha^{-1})
Compost-6 (Raw coir pith predigested by using *Pleurotus sajor-caju* and *Eudrilus eugeniae* (5 t ha^{-1})

Fungal population

On the 30th day, the total fungal count was significantly increased in C_6 (1.36×10^4), followed by C_3 (1.20×10^4) compared to Control (1.08×10^4). On the 60th day a remarkable increase was noted in C_6 (2.16×10^4), C_3 (2.02×10^4) over the control (1.62×10^4). Last phase of decomposition (on the 90th day) also showed favorable number of fungal population in the earthworm-worked substrates C_6 (1.52×10^4), C_3 (1.50×10^4) and C_2 (1.36×10^4) over the control (1.19×10^4).

Figure2



C- Control
Compost-1 (Raw corncob composted by using *Pleurotus sajor-caju* (5 t ha^{-1})
Compost-2 (Predigested raw corncob + *Eudrilus eugeniae* (5 t ha^{-1})
Compost-3 (Raw corncob predigested by using *Pleurotus sajor-caju* and *Eudrilus eugeniae* (5 t ha^{-1})
Compost-4 (Raw coir pith composted by using *Pleurotus sajor-caju* (5 t ha^{-1})
Compost-5 (Predigested raw coir pith + *Eudrilus eugeniae* (5 t ha^{-1})
Compost-6 (Raw coir pith predigested by using *Pleurotus sajor-caju* and *Eudrilus eugeniae* (5 t ha^{-1})

Figure 3
Bacterial population on 0-30 days

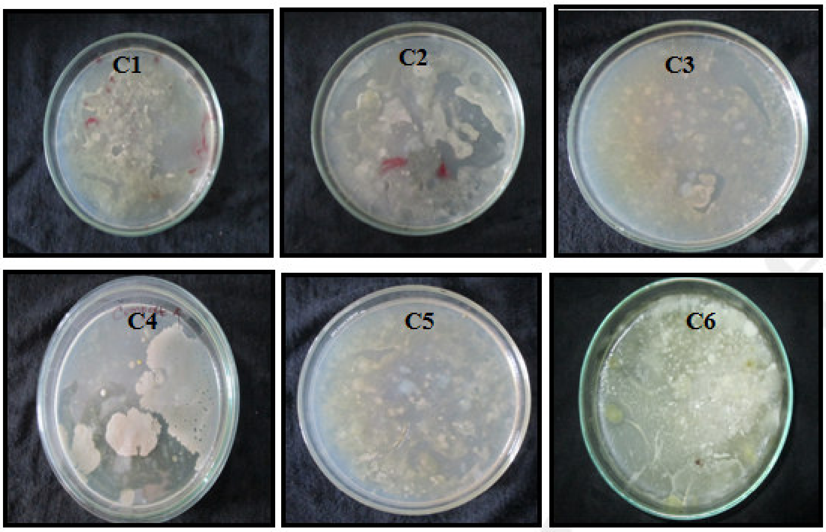


Figure 4
Bacterial population on 30-60 days

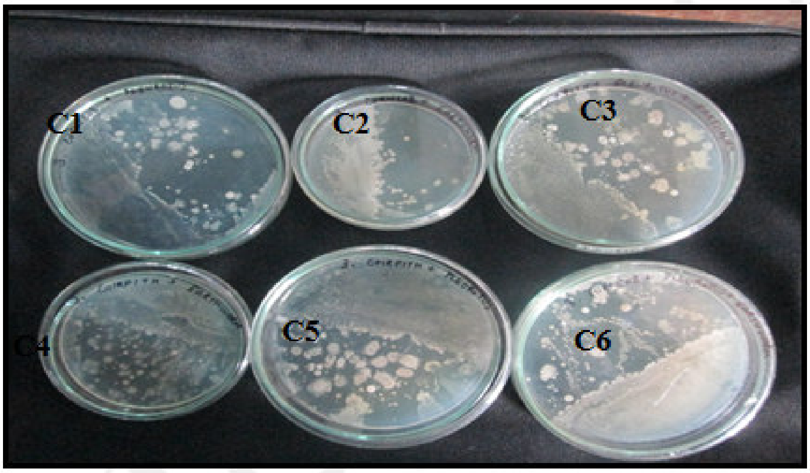


Figure 5
Bacterial population on 60-90th days

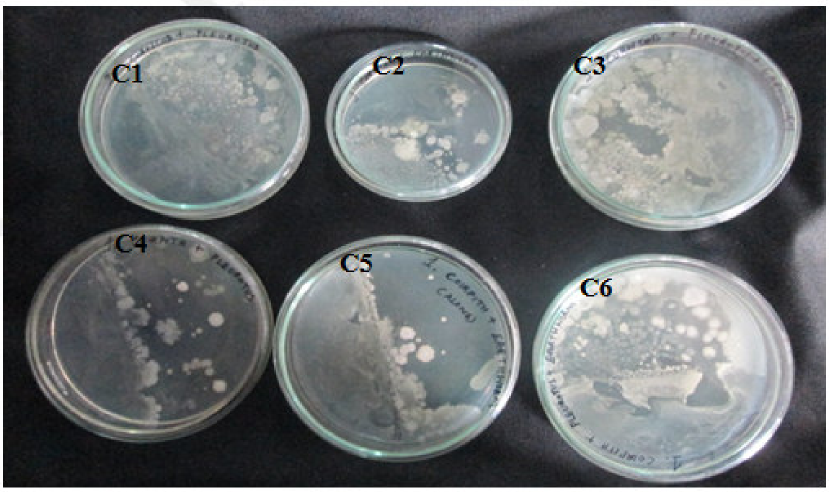


Figure 6
Fungal population on 0-30 days

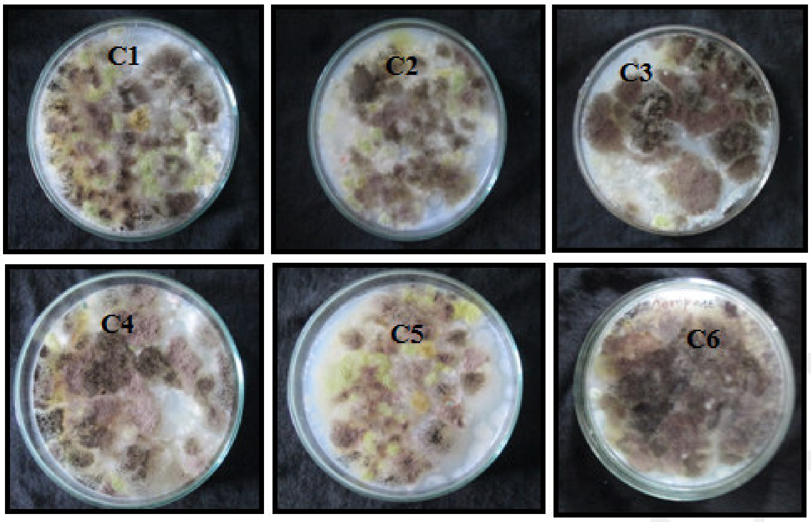


Figure 7
Fungal population on 30-60 days

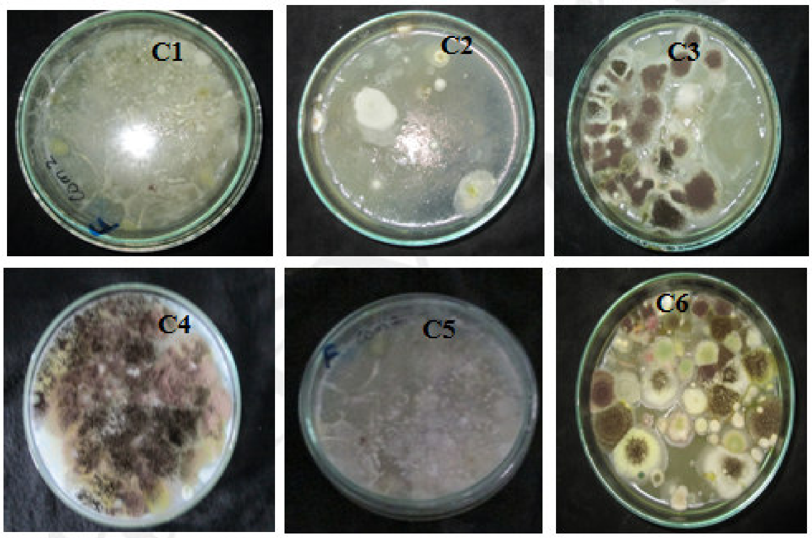
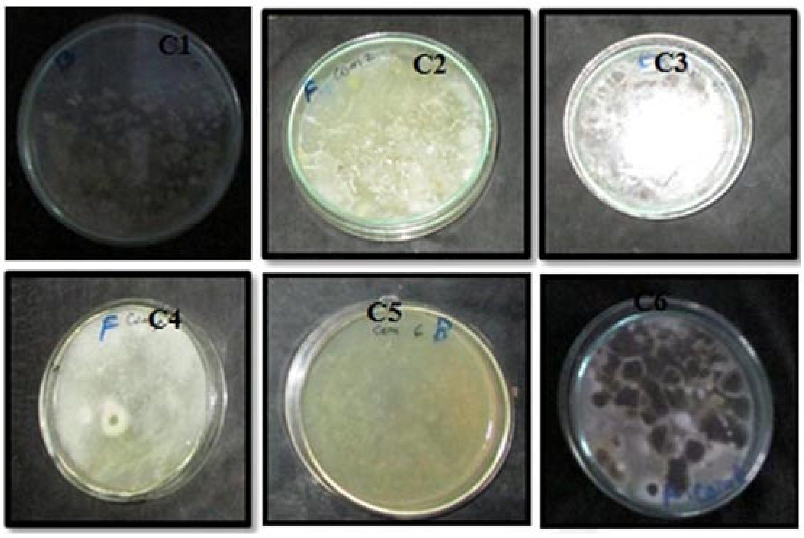


Figure 8
Fungal population on 60-90 days



The bacteria and fungi count increased conspicuously from 0-30 to 30-60 days and from 60-90 days and decreased from 60-90 days. (fig 6, 7, 8). The C_6 and C_3 compost would have increased micronutrient contents, which might have enhanced the microbial population. The present study clearly indicated that combined use of organic substrates improved the microbial load of the compost rather than single organic substrate application. The present observation is in accordance with the findings[6]. They found maximum microbial population (bacteria 1756×10^6 g^{-1} and fungi 348×10^4 g^{-1}) with the activity of *Eudrilus eugeniae* in the press mud substrate. The present result coincides with the result[4] who observed maximum increase in bacteria (1.31×10^7 g^{-1}) and fungi (1.37×10^7 g^{-1}) population with the application of worm-worked substrates of *Polyalthia longifolia* + cow dung compared to worm-unworked substrates. Similar result was positively correlated with the findings[7] who recorded maximum population of bacteria, fungi and actinomycetes in the application of FYM + neem cake. Bacteria and fungi, especially cellulolytic fungi, also play an important role during vermicomposting. Population of cellulolytic fungi was found to be increased during vermicomposting of different organic wastes[8]. They reported combined use of organic manures improves the microbial population compared to single organic manure application. These findings were found in line with the work[3]. The highest bacteria (28) and fungi (12) population were recorded for the combined application of vermicomposting of coir pith + cow dung + panchagavya. Similar reports were positively correlated with the findings[9]. They found that the percentage of increase is 28.5% (bacteria) and 62.5% in fungi in the *Eudrilus eugeniae* worked substrate of tendu leaf litter compared to Control. These findings were found in line with the work[10]. They found the highest bacterial population (634) and fungal population (113) in the garbage mixed without cow dung slurry vermicompost and garden trimming leaves vermicompost, respectively. The present result was supported by the findings[11]. They found maximum bacterial and fungal count was in vermicomposted water hyacinth. The present observation is in accordance with the findings[12] who observed that total microbial population (3.89 CFU$\times10^6$ g^{-1}) in the combined application of 600g tea waste + 100g cow dung + 300g kitchen waste compost. The present study was positively correlated with the findings[13] who observed that maximum bacteria (126×10^6) and fungi (28×10^6) was found in vermicompost. The similar work was supported by[14]. They found increased bacterial population (80×10^6 CFU) in vermicompost. The present result was coincides with the result of [15] who observed maximum bacterial population 7.2 $\times10^9$ CFU during the composting of municipal solid waste in rainy season. The drastic increase in microbial population in the biocompost was not only due to increment of nutrients but also due to the mineralization of organic matter produced by microorganisms. The enhancement of the microbial population might be due to the contribution of intestinal flora of the earthworm which helps in the mineralization of corncob and coir pith.

CONCLUSION

The present study concluded that Compost-6 (Raw coir pith predigested by using *Pleurotus sajor-caju* and *Eudrilus eugeniae* (5t ha^{-1}) and Compost-3 (Raw corncob predigested by using *Pleurotus sajor-caju* and *Eudrilus eugeniae* (5t ha^{-1}) is microbiologically more active than the worm-untreated substrates. This process is the most efficient method of waste management by using white rot fungi (*Pleurotus sajor-caju*) and earthworm (*Eudrilus eugeniae*). The agro-industrial waste corncob and coir pith can be converted into biocompost which might result in increased plant growth and yield.

CONFLICT OF INTEREST

Conflict of interest declared none.

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