Accelerated Composting by Applying Compost Product as inoculum

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INTRODUCTION

The development of human civilization is often accompanied by the production of organic waste and the accompanying environmental problems. The treatment of those organic wastes has always been a concern of society. Composting is considered to be the most effective and environmentally friendly. Organic matter will be degraded by microorganisms, most of which will be decomposed into inorganic carbon and nitrogen and released as gas. The remaining part can be used as organic fertilizer (Epstein 2017).

Commercial inoculants need to be evaluated for their effectiveness in improving compost. But no positive effect of inoculation on the improvement of organic matter degradation according to previous studies. Acclimatization can effectively increase microbial activity and improve composting efficiency. This study investigated the effect of acclimatization of commercial inoculum on organic matter degradation during composting and explored the changes in enzyme activities related to organic matter degradation.

MATERIALS AND METHODS

Materials preparation

Oil cake (organic waste). Sawdust (bulking agent) and inoculum (commercial inoculum or compost samples) are mixed in a ratio of 15:4:1 as organic matter for composting, C/N ratio 7.07).

Apparatus and Composting conditions:

A small oval reactor was used for composting, filled with 12g of mixed organic matter. The initial moisture content of the compost was adjusted to 60%. Set the initial temperature to 30°C and raised to 60°C within 12 hours, then keep it at 60°C. The flow rate of the air inlet of the reactor was set to 5.5 mL/min. Connected a gas bag to the outlet of the reactor to collect the gas produced by the compost.

The first composting experiment was named Run A which was used for acclimatization, apply one kind of commercial inoculum. The control group (Blank) used sterilized commercial inoculum as the inoculum. During the composting of Run A, samples on the third, fifth, and tenth days were taken out, used as inoculum, start new composting by using the samples of Run A were named C3, C5, and C10.

Physico-chemical and biological properties of composts:

Changes in the moisture content, CO_2 emission, pH value were periodically analyzed in the compost samples. All analyses were carried out in triplicate as a minimum. 16S rRNA gene regions of bacteria were used for next-generation sequencing analysis. DNA from the compost samples were extracted using the ISOIL for Beads Beating Kit (No. 319-06201, Nippon Gene Co. Ltd., Japan) according to the instructions.

The enzyme activities related to the degradation of organic matter were measured by using the API ZYM

kit, according to the reported instructions (Humble et al., 1977)

RESULTS AND DISCUSSION

Effect of using commercial inoculum and compost sample as inoculants on composting efficiency:

The emission of CO_2 was the final product of organic matter degradation. The use of commercial inoculum composting group Run A could not significantly increase the emission of CO_2. Compared with the Run A, the CO_2 emission were significantly improved in C3, C5, C10, especially at the early stage of composting. The biggest improvement was the C10 which used the tenth day of compost sample, followed by C5 and C3 and the cumulative CO_2 emission at the end of composting was much higher. Interestingly, this observation is contradicting with the previous understanding that microbial inoculation has little effect on the improvement of organic matter degradation. This showed the microbial activities in the acclimatized compost sample have increased, which accelerated organic degradation in the initial stage of composting.

Changes in enzyme activity related to organic matter degradation during composting:

Changes in the activity of different types of enzymes during the composting process were measured as well, including carbohydrate-active enzymes, proteases, lipases. C3, C5, and C10 all show high enzymatic activity. Compared with Run A, the rapid degradation of organic matter largely depends on high-activity degradation-related enzymes. These enzyme activities were positively related to the rate of CO_2 emission. Appropriate selection of inoculum can increase the activity of related enzymes, which is mainly due to the microbial activities (Altun et al., 2020). From this point of view, the acclimatized microbial community is more suitable for use as an inoculum for composting, and the extracellular enzymes secreted by dominant microorganisms can greatly promote the degradation of organic matter.

CONCLUSION

This study evaluated the improvement in the performance of commercial inoculants by acclimatization. Acclimatized microorganisms accelerated the degradation of organic matter in the composting and significantly increase the CO_2 emission. Acclimatized inoculum significantly increased the activity of enzymes related to the degradation of organic matter and accelerated composting progress.

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