J. Sci. Trans. Environ. Technov. 2009, 3(2): 50 - 53

Efficacy of lignocellulosic fungus *Pleurotus sajor-caju* in hastening the poultry waste composting

M. Prasanthrajan* P. Doraisamy and S. Marimuthu

Department of Environmental Sciences, Tamil Nadu Agricultural University, Coimbatore - 641 003, Tamil Nadu, India

Abstract

Efficacy of the ligno-cellulosic fungus *Pleurotus sajor-caju* in hastening the poultry waste composting process was tested by mixing the poultry wastes with different indigenous carbonaceous waste materials, namely, coir pith and paddy straw. The compost mix inoculated with *Pleurotus sajor-caju* attained its maturity on 45th day of composting whereas uninoculated compost mix attained maturity during 60th day of composting. The C/N ratio of the compost mix inoculated with *Pleurotus sajor-caju* ranged from 10.16 to 11.80 and in the uninoculated compost mix ranged from 15.96 to 18.80 on the 45th day of composting. Further more *Pleurotus sajor-caju* also played a significant role in increasing the phosphorus and potassium content of the compost mix.

Keywords : carbonaceous wastes, C/N ratio, composting, ligno-cellulosic fungus, *Pleurotus sajor-caju*, poultry wastes, rock phosphate

INTRODUCTION

Earth has an unlimited supply of resources to which we gain access through science and technology. Solid wastes from towns, cities, agricultural and industrial sectors account for bulk of the wastes generated in India. Vast quantities of solid wastes are produced in India from various origins such as agricultural, domestic, community, fruit and vegetable, animal and poultry, industrial, mining and construction project wastes.

Poultry industry is one of the largest and fastest growing livestock production systems in India. Poultry manure can be composted with various carbonaceous bedding, materials like rice straw, wood chips (Mahimairaja *et al*., 1994), sawdust, coir pith, paddy straw, paper waste and leaf litter (Prasanthrajan *et al.,* 2004). The recent rise in composting interest has come from the need for waste management solutions which emphasize economical and environmental alternatives. Generally composting is a time consuming process. This paper describes the use of lingo-cellulosic fungi *Pleurotus sajor-caju* to reduce composting time for poultry wastes.

METHODS

The introduction of microorganisms in the compost heap while making compost has an important role since the microorganisms increase the rate of degradation of the organic matter in the compost mix. The raw materials used in the present study, namely, coir pith and paddy straw are lingo-cellulosic in nature. The microorganism *Pleurotus sajor-caju* was inoculated @ 5 packets (250 g each) per ton of compost mixture. The raw materials *viz.,* paddy straw, coir pith and poultry droppings were mixed in different proportions in order to attain the C/N ratio to be 25 - 30:1, which is considered to be a suitable C/N ratio for making compost. Rock phosphate @ 2.5 kg 100 kg^{-1} was also added as nutrient source as per the treatment combinations given in Table 1. Two kg of raw materials were taken in compost chamber and the moisture was maintained at 60%. Periodical samples were drawn from different compost mixes at fortnightly intervals, processed and analyzed for various chemical properties *viz*., pH, Electrical conductivity, organic carbon, total N, P and K, ammonia, CO_2, cellulose and lignin by following standard analytical methods.

RESULTS AND DISCUSSION

The present study confirmed that *Pleurotus sajor-caju* played a major role in reducing the volume of the mix. *P. sajor-caju* inoculated compost mix attained its maturity on 45th day of composting whereas uninoculated compost mix attained the maturity during 60th day of composting and thus the fungi reduced the composting period by 15 days. *P. sajor-caju* reduced the electrical conductivity and organic carbon content of the compost mixes whereas the changes in pH were not remarkable (Table 1). A great loss in carbon was recorded in the compost mix inoculated with *P. sajor-caju* on the 45th day of composting where as a minimum loss of carbon was noticed in uninoculated compost mix on the 60th day of composting. The total nitrogen content of the compost mix inoculated with *P. sajor-caju* was high when compared to uninoculated compost. The increase in nitrogen content might be due to the quick reduction in volume of the compost mix (Prasanthrajan *et al*., 2004).

*Corresponding Author
email: *prasanth_phd@yahoo.co.in*

Table 1. Changes in pH, EC, Total carbon, Total N, C/N ratio during the decomposition of poultry wastes in conjunction with carbonaceous wastes and the lingocellulosic fungus *Pleurotus sajor-caju*

Treatments*	pH				EC (dS m^{-1})				Total carbon (percent)				Total N (percent)				C /N ratio			
	0th day	30th day	45th day	60th day	0th day	30th day	45th day	60th day	0th day	30th day	45th day	60th day	0th day	30th day	45th day	60th day	0th day	30th day	45th day	60th day
T_1	7.30	8.10	7.90	7.60	1.16	1.28	1.30	1.34	42.12	36.12	32.16	28.19	1.67	1.69	1.71	1.83	26.16	21.37	18.80	12.67
T_2	7.20	7.80	7.70	7.40	1.05	1.13	1.17	1.21	40.46	33.21	28.42	23.12	1.62	1.68	1.82	1.94	24.07	19.77	15.61	11.92
T_3	7.40	8.20	7.70	7.60	1.08	1.15	1.15	1.18	40.02	32.02	28.40	22.31	1.67	1.70	1.78	1.99	25.47	18.84	15.96	11.21
T_4	7.40	7.70	7.50	7.40	1.12	1.29	1.29	1.30	42.13	28.16	22.30	21.90	1.71	1.83	1.89	1.92	24.64	15.39	11.80	11.40
T_5	7.20	7.60	7.60	7.50	1.00	1.10	1.14	1.17	40.16	25.12	20.63	20.00	1.73	1.89	2.03	2.03	23.21	13.29	10.16	9.61
T_6	7.30	7.70	7.40	7.40	1.06	1.13	1.14	1.15	40.20	25.06	20.52	20.02	1.66	1.87	2.00	2.03	24.22	13.40	10.26	9.86
S.Ed	0.117	0.090	0.086	0.069	0.012	0.048	0.018	0.015	0.969	0.359	0.303	0.868	0.019	0.041	0.021	0.022				

T_1-Poultry droppings + Paddy straw
T_2- Poultry droppings + Coir pith
T_3- Poultry droppings + Coir pith + Rock phosphate
T_4- Poultry droppings + Paddy straw + *Pleurotus sajor- caju*
T_5- Poultry droppings + Coir pith + *Pleurotus sajor- caju*
T_6- Poultry droppings + Coir pith + Rock phosphate + *Pleurotus sajor- caju*

Table 2. Changes in total P, K, Cellulose and Lignin content during the decomposition of poultry wastes in conjunction with carbonaceous wastes and the lingocelluloric fungus *Pleurotus sajor-caju*

Treatments	Total phosphorus (%)				Total potassium (%)				Cumulative Carbon dioxide release (mg 100 g^{-1})				Cellulose content (%)			Lignin content (%)		
	0th day	30th day	45th day	60th day	0th day	30th day	45th day	60th day	0th day	30th day	45th day	60th day	0th day	30th day	45th day	0th day	30th day	45th day
T_1	1.72	1.80	1.83	1.85	1.10	1.21	1.25	1.29	15	132	170	197	20.16	17.62	12.16	16.12	12.10	3.14
T_2	1.74	1.79	1.86	1.86	1.19	1.25	1.27	1.35	13	127	169	187	32.12	22.16	9.20	45.16	36.12	14.62
T_3	1.75	1.87	1.94	2.05	1.17	1.26	1.28	1.33	17	141	185	203	33.12	21.32	10.21	45.25	35.12	14.91
T_4	1.68	1.85	1.85	1.89	1.08	1.26	1.27	1.31	19	158	200	221	22.19	14.16	4.12	17.64	12.00	3.02
T_5	1.72	1.86	1.92	1.93	1.24	1.32	1.38	1.41	24	171	220	230	30.15	13.12	5.63	45.74	32.12	8.12
T_6	1.72	1.89	2.13	2.17	1.20	1.28	1.36	1.39	24	163	214	226	31.67	13.65	4.17	45.28	33.06	8.98
S.Ed	0.016	0.078	0.044	0.022	0.012	0.012	0.012	0.015	-	-	-	-	0.480	0.435	0.104	0.642	0.271	0.073

T_1-Poultry droppings + Paddy straw
T_2- Poultry droppings + Coir pith
T_3- Poultry droppings + Coir pith + Rock phosphate
T_4- Poultry droppings + Paddy straw + *Pleurotus sajor- caju*
T_5- Poultry droppings + Coir pith + *Pleurotus sajor- caju*
T_6- Poultry droppings + Coir pith + Rock phosphate + *Pleurotus sajor- caju*

An earlier report shows that composting period was reduced from 46 days to 23 days when a substrate comprised of plant materials and chicken manure was composted with *Trichoderma harzianum* which was used as an activator (Cuevas *et al*., 1988).

The C/N ratio of the compost mix inoculated with *P. sajor-caju* ranged from 10.16 to 11.80 on the 45th day of composting whereas the C/N of the uninoculated compost mix ranged from 15.96 to 18.80 ever after 45th day of composting (Table 1). The reduction in C/N ratio might be due to the decrease in carbon content which was utilized by the micro flora as energy source and consequent conversion into nitrogen (Kithome *et al*., 1999).

Composting of waste materials with rock phosphate has been practiced widely as a low input technology in improving the fertilizer value of the manure (Mahimairaja *et al*., 1995). *P. sajor-caju* also played a role in slightly increasing the phosphorus and potassium contents of the compost mix (Table 2). As the degradation activity in the inoculated treatments increased, more CO_2 release was recorded than in the uninoculated treatments (Table 1). A drop in ammonia loss was also recorded in compost mix inoculated with *P. sajor-caju*. This organism played a key role in bringing the carbon source available, which could have contributed to the reduction of NH_3 in the compost mix.

As the coir pith and paddy straw were rich in cellulose and lignin, the present experiment was conducted to test the efficiency of *P. sajor-caju* in hastening the composting process and the results of the present study showed that the lignocellulosic fungi, *P. sajor-caju* was found to be efficient in reducing the cellulose and lignin contents of the waste. The initial cellulose content of the mix which ranged from 20.16 to 33.12 %, got reduced to 9.20 to 12.16 % in the uninoculated compost and 4.12 to 5.63 % in the inoculated compost mix during maturity. Also, a greater reduction in lignin content was recorded in the inoculated mix as it reduced from the initial values of 16.12 to 45.74 % to 3.14 to 14.91 % in the uninoculated compost mix and from 3.02 to 8.98 % in the inoculated compost mix on the 45th day of composting.

CONCLUSION

The total carbon and C/N ratio of the compost mixes got reduced with the advancement of composting. The cumulative CO_2 release was high in *P. sajor-caju* inoculated compost mixes which recorded rapid reductions in cellulose and lignin contents. The raw materials inoculated with *P. sajor-caju* attained composting maturity in 45 days where as the uninoculated raw materials attained their maturity in 60 days. In short, inoculation of *P. sajor-caju* in poultry wastes composting reduced the compost period from 60 days to 45 days and also improved the nutrient contents and compost value.

REFERENCES

Cuevas, V.C., Samulde, S.N. and Pojola, P.G. 1988. *Trichoderma harzianum*, an activator for rapid composting of agricultural wastes. *Philipp. Agriculturalist*, 71: 461-469.

Kithome, M., Paul, J.W. and Bomke, A.A. 1999. Reducing nitrogen looses of manure using adsorbents and chemical amenders. *J. Environ. Qual.*, 28: 194-201

Mahimairaja, S., Bolan, N.S. and Hedley, M.J. 1995. Agronomic effectiveness of poultry manure compost. *Commun. Soil Plant Anal.*, 26 (11&12): 1843-1861.

Mahimairaja, S., Bolan, N.S., Hedley, M.J. and MacGregor, A.N. 1994. Losses and transformation of nitrogen during composting of poultry manure with different amendments: An incubation experiment. *Bioresour. Tech.*, 47: 265 273.

Prasanthrajan, M., Doraisamy, P. and Avudainayagam, S. 2004. Screening of suitable indigenous carbon source for nitrogen conservation in poultry manure. *In: National Symposium on recent trends in applied biology.* EB/ 0-20 P. 158-159 held at: Avinashilingam Institute for Home Science and Higher Education - Deemed University, 28&29, January 2004.