Pak. J. Bot., 43(6): 3049-3051, 2011.

BIOCONVERSION OF DRIFTED SEAWEED BIOMASS INTO ORGANIC COMPOST COLLECTED FROM THE KARACHI COAST

TOOBA HAQ*, FAROOQ AHMED KHAN, RAZIA BEGUM AND ALIA BANO MUNSHI

PCSIR Labs Complex, Shahra-E-Salimuzzaman Siddiqui, off University Road Karachi- 75280, Pakistan.

Abstract

Present bioconversion studies were carried out to convert drifted seaweed biomass into bioactive organic compost. Chemical analysis of the collected seaweed biomass from the Karachi coast revealed 60.30 % organic matter. Aerobic composting method i.e., windrow composting technique was applied for the conversion of collected seaweed biomass into organic compost. Employing this technique almost 70% biomass was converted into organic compost. On analysis, the compost obtained by the above method showed 2.3% Nitrogen, 0.86% Phosphate and 1.8% Potassium. Results for the analysis of heavy metals showed Mercury 0.05 mg / kg, Arsenic BDL Cadmium 0.080 mg / kg and Copper 7.1 mg / kg. Results for the biological evaluation of seaweed compost showed 78% germabilty while the Biogold and cow dung showed 83 and 60% germabilty.

Introduction

Seaweeds are marine and brackish water macro algae (Michank, 1975).Seaweeds has been proved to be the rich source of plant growth hormones and soil conditioner (Han *et al*., 2000). The effect of algal carbohydrates on plant pathogens not only has manorial effects but its use may also confer a degree of immunity to certain common soil borne diseases (Bi *et al*., 2003). Seaweeds are known to stimulate growth of vegetables, fruits and other crops (Blunden 1991; Crouch & Van Staden, 1994; Washington *et al*., 1999). They contain all major and minor plant nutrients as well as biocontrol properties and many organic compounds such as auxins, gibberellins and precursors of ethylene and betine which affect plant growth (Wu *et al*., 1997).

Along the coast lines of Pakistan a large number of bathetic algae and seaweed species are usually found lying on the beaches during the ebb of sea waters either as drift or entangled with rocks, or growing submerged in the water pools. In the coastal belt of Pakistan , about 70 species and 27 genera of seaweeds are available (Haider *et al*., 2009). A survey report of 1997-1998 indicates that the highest seaweed biomass was collected from Manora coast, approximately $6kg/m^2$ from drifted seaweeds and 21 kg/m^2 from attached seaweed. The most abundantly available species of seaweeds reported at Karachi coast are *Ulva fasiata, Chondria tennussima, Sargassum* spp., and *Valoniopsis pachyema*. (Haider *et al*., 2009; Aliya & Shameel, 1999; Zahid *et al*., 2000).

Continuous use of chemical fertilizers is leading reduction in the crop yield and resulted in imbalance of nutrients in the soil, which has adverse effects on soil health. Use of organic manures alone or in combination with chemical fertilizers will help to improve physico-chemical properties of the soil, efficient utilization of applied fertilizers for improving seed yield. Organic manures provide a good substrate for the growth of micro-organisms and maintain a favorable nutritional balance and soil physical properties (Maheshbabu *et al*., 2008). Nutrients contained in organic manures are released more slowly and are stored for a longer time in the soil, thereby ensuring a long residual effect. Improvement of environmental conditions and public health as well as the need to reduce costs of fertilizing crops are also important reasons for advocating increased use of organic materials (Sharma & Mittra, 1991)

To explore the alternative source of low cost, organic fertilizer rich in minerals and other essential elements, available natural resources such as seaweeds can be processed as fertilizer / soil conditioner (Eyras *et al*., 2008; Usmani *et al*., 1987; Ryckeboer 2003). The present study was, therefore, undertaken to develop a simple economically feasible technique for the conversion of seaweed biomass into compost by composting technique.

Material and Methods

Four truckloads of seaweed (each truck of 01 ton capacity) were collected from Cape Monze & Manora and brought to the laboratories. Fresh Cow manure was procured from cattle barns. Representative sample of 01 kg was drawn for chemical analysis.

Composting process: Experiments were carried out at PCSIR Labs Complex Karachi during the month of May-June. 750 Kgs seaweed feed was prepared (I.e. one part cow dung and two parts of seaweeds), prior to composting moisture content and C / N ratio was adjusted. The pile of the prepared feed was covered with the layers of straws for insulation. Temperature readings were taken on daily basis by thermocouple. Windrow pile was overturned and watered on weekly basis. Moisture content was determined through the weight loss at 105°C (A.O.A.C. 2005). After 40 days composted mass was thereafter left for a week to mature. It was then dried and sieved.

Chemical analysis: Compost thus obtained was analyzed for the determination of its chemical composition. Nitrogen, phosphorus and potassium were estimated by using standard Kjheldahl method, spectrophotometric and flame photometric methods respectively. pH, total solids, volatile solids, moisture content, bulk density and soluble salts (1:2 extract was used) were also determined (A.S.T.M. Standards, 2007 & Anon., 2005).
Heavy metal composition was estimated by Atomic Absorption Spectroscopy (Anon., 1998). Estimation of Mercury was performed on Atomic Absorption Spectroscope model AASZ-5000 while, Arsenic, Copper and Cadmium were done on model AASZ-8000.

Result and Discussion

At the time of collection, seaweed biomass was malodorous and discolored which indicate that the biomass was in its decomposition stage. Data in Table 1 showed that the seaweed biomass had average moisture 83.9 %, total volatile solids 60.3%, total inorganic solids 39.7%, pH 6.8, and C / N ratio 18/1. This analysis revealed that seaweed biomass was suitable for composting by employing aerobic composting techniques. Cow manure as a suitable microbial inoccula was mixed with the seaweed biomass. Cow manure was added in the ratio of 1:2 (i.e. 1 part Cow manure and 2 parts seaweed). Chemical analysis of raw Cow manure is mentioned in Table 1.

Table 1. Chemical composition of raw materials used for composting process.

Parameters	Seaweed average analysis	Cow dung average analysis
pH	6.8	7.3
Moisture %	83.9	78.60
Total solids %	16.10	21.40
Volatile solids %	60.30	77.50
Inorganic %	39.70	22.50
Carbon %	33.13	42.58
Nitrogen %	1.88	1.65
C / N Ratio	18 / 1	26 / 1
Odor	Seawater like but unacceptable smell	Typical dung smell

During the thermophilic phase of the composting process temperature reached up to 50°C and lasted for 3 weeks. After day 30, the temperature dropped dramatically and reached up to ambient levels i.e. 36°C by day 37. Moisture content was maintained above 50% until day 35, after completion of the composting process windrow pile was dismantled and the material was allowed to dry naturally by sun drying. It was noticed that volatile solids content declined from 44.90% to 27.50% after the completion of composting process. Composting process took 40 days for completion, with 70% compost yield. Chemical analysis of prepared compost showed 27.50% volatile solids, 2.3% nitrogen, 0.86% phosphate and 1.8% potassium with typical compost like smell. Heavy metal estimation showed *Hg* 0.05 mg / kg, *As* BDL (i.e. below detection limit) *Cd* 0.080 mg / kg and *Cu* 7.1 mg / kg (Table 2). After comparison with maximum acceptable concentrations all the obtained values were found in acceptable range. (Agriculture and Agrifood Canada, Trade Memorandum, T-4-93, July 1995).

Table 2. Chemical composition of finished Seaweed organic compost.

Sr. #	Parameters	Seaweed organic compost
1.	pH	7.1
2.	Moisture %	4.95
3.	Total solids %	95.05
4.	Volatile solids %	27.50
5.	Inorganic %	72.49
6.	Carbon %	15.11
7.	Nitrogen %	2.3
8.	C / N Ratio	7 / 1
9.	Soluble salts mmhos/cm	3.59
10.	Bulk density Ib/yd^3	1278
11.	Odor	Typical compost like

Comparative study based on the chemical composition of cow dung (CD), seaweed organic compost (SWOC) and Biogold organic compost (BGOC) (commercial product) were also done. Results clearly revealed percentage of nitrogen, phosphate and potassium (NPK) for soil (0.3%, 0.1% and 0.3% respectively), CD (1.65%, 1.20%, and 1.62% respectively) BGOC (2.5%, 0.32% and 0.87% respectively) and SWOC (2.3%, 0.86% and 1.8% respectively) Data comparisons indicate that SWOC give relatively high percentage of NPK. Effect of SWOC, CD and BGOC on seed germination of *Zea mays* was also observed. Seaweed compost showed 78% seed germination while cow manure and BGOC showed 60% and 83% seed germination respectively (Fig. 1). It may therefore be assumed that SWOC is as good as organic manure and BGOC. Its efficacy can further be improved if applied to soil in appropriate dosage from time to time or by addition of synthetic nutrients as being done in commercial products such as BGOC.

Based on the above discussion it may be concluded that the resulting composts were of good quality in terms of nutrient content and low heavy metal content. This demonstrates that composting technology can be used as an alternative treatment method to turn seaweed biomass into compost that can be used as organic amendments or fertilisers for agricultural systems.

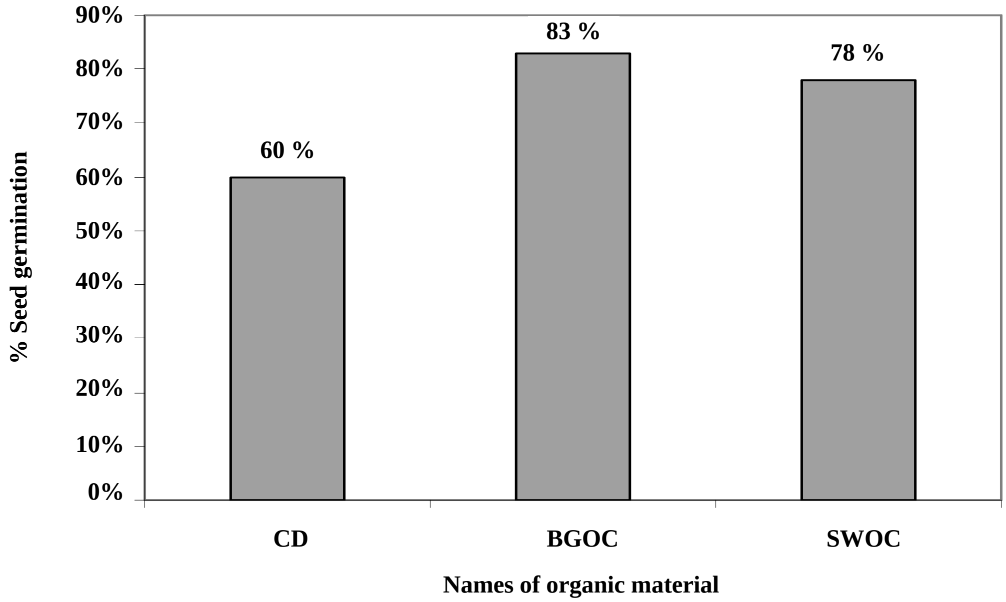

Fig. 1. Effect of cowdung, biogold organic compost & seweed organic compost on *Zea mays* seed germination.

References

Aliya, R. and M. Shameel. 1999. Phycochemical evaluation of four coenobitic green Seaweeds from coast of Karachi. *Pak. J. Marine Biology*, 5(1): 65-76.

Annual Book of ASTM standards. 2007. Section 4, Vol. 04.08.

Anonymous. 1998. *Standard Methods for the Water and Waste Water*. American Public Health Association, Washington D.C., USA, 20th ed.

Anonymous. 2005. William, H. *Association of Analytical Chemistry* 18th edition AOAC International Gaithersburg Maryland.

Bi, F. and S. Iqbal. 2003. Dose dependent and time course elicitor activity of *Codium elongatum* and *Ulva lactulus* of Karachi coast. *Pak. J. Bot*., 35(4): 511-518.

Blunden, G. 1991. Agricultural uses of seaweeds and seaweed extracts. In: *Seaweed resources in Europe: Uses and potential*. (Eds.): M D Guiry and G Blunden, John Wiley & Sons, Chichester, pp. 65-81.

Crouch, I.J., and J. Van. Staden. 1994. Commercial seaweed products as biostimulants in horticulture. *J. Home Consum. Hort*., 1: 19-76.

Eyras, M.C., A. Defoss and F. Dellatorre. 2008. Seaweed Compost as an Amendment for Horticultural Soils in Patagonia, Argentina. *Compost Science & Utilization*, 16(2): 119-124.

Haider, S., X.L. Zhen, L. Hong, K. Jamil and C.G. Yong. 2009. Anti-allergic effects of ethanol extracts from brown seaweeds. *J. Zhejiang Univ. Sci. B.* 10(2): 147-153.

Han, L. F. Xiao and F. Guoming. 2000. Effect of seaweed on germination of vegetable seeds Hiayang Kexue. *Chemical Abstract*, 136(9) ISSN: 0009-2258.

Maheshbabu, H.M., R. Hunje, N.K. Biradar Patil and H.B. Babalad. 2008 Effect of organic manures on plant growth, seed yield and quality of soybean. *Karnataka J Agric. Sci*., 21(2): 219-221.

Michank, G. 1975. Seaweed resources of the ocean. FAO Fisheries Technical Paper, 130. Food and Agriculture Organization, Rome.

Ryckeboer, J., J. Mergaert and J. Swing. 2003. Microbiological aspects of biowaste during composting in monitored compost bin. *Journal of Applied Microbiology*, 94(1): 127-137.

Sharma, A.R. and B.N. Mittra. 1991. Effect of different rates of application of organic and nitrogen fertilizers in a rice-based cropping system. *Journal of Agricultural Science*, 117: 313-318.

Usmani, N.F., R. Khatib and S.S. Hussain. 1987. Conversion of domestic garbage into compost using three different techniques. *Pak. J. Sc. Ind. Res*., 30(10): 772-776.

Washington, W.S., S. Engleitner, G. Boontjes and N. Shanmuganathan. 1999. Effect of fungicides, seaweed extracts, tea tree oil and fungal agents on fruit rot and yield in strawberry. *Aus. J. Exp. Agric*., 39: 487-494.

Wu, Y.T. Jenkins, G. Blunden, C. Whapham and S.D. Hankins. 1997. The role of betaines in alkaline extracts of *Ascophyllum nodosum* in reduction of Meloidogyne javanica and M. incognita infestations of tomato plants. *Fund Appl. Nematol*., 20: 99-102.

Zahid, P.B. and H. Usman. 2000. Evaluation of seaweed resources of Pakistan Proceedings of National O.N.R. Symposium on Arabian Sea as a resource of biological diversity. H.E.J. Research Institute of Chemistry University of Karachi. pp. 115.

(Received for publication 16 January 2010)