RESEARCH PAPER

Assessment the Clean Index and Fertilizing Index of Some Imported Composts to Erbil City

Shakar Jamal Aweez¹ Sadeq, Dalshad Azeez Darwesh²
1,2 Department of Environmental sciences, College of Science, Salahaddin University-Erbil, Kurdistan Region, Iraq.

ABSTRACT:
This study was carried out for assessing the clean and fertilizing indices of diverse composts from various countries imported to Erbil city. The compost samples included 4 most common compost kinds (Indian, Dutch, Estonia and local produced) with five replications were bought in different local agrochemical market and shopping. The experimental designed completely randomized design (CRD). The results revealed that the fertilizer index (FI) of imported and local compost was varied from 4.13 to 4.47 where as the clean index(CI) was varied from 3.20 to 3.93, all composts have a fertilizer potential value >4, however the clean index value of compost has medium heavy metals content, the statistical analysis in the present study indicated that imported and local compost has a good quality and proper for agriculture land.

KEY WORDS: Compost, Fertilizing index, Clean index, Heavy Metals
DOI: http://dx.doi.org/10.21271/ZJPAS.31.4.13
ZJPAS (2019) , 31(4):123-128 .

INTRODUCTION

Compost is resulting from the decomposition of organic matter. The compost involved garden waste, house holed solid waste, kitchen scraps, manure, leaves, grass clippings, and compost bears slight physical similarity to the raw material from which it originated. Composting of degradable wastes is seen as a method of diverting organic waste materials from landfills and creating a product, relatively effective in cost that is suitable for agricultural purposes. In addition to its potential beneficial components some waste materials may also contain nonessential elements, persistent organic compounds and microorganisms that may be harmful to the plants and environment. Heavy metals released from various sources may finally reach to the surface soil, and their further fate depends on soil physical and chemical properties such as pH, redox potential, (Mora, 2006). The presence of heavy metals in compost raises significant concern about its adverse impact on the environment as a result of excessive compost application to agricultural lands. High and excessive accumulation of heavy metals in the soil may eventually contaminate both human and animal food chain. Heavy metals can affect the growth, morphology, and metabolism of soil microorganisms, and diminish both the population and activity of microbial pools, therefore decrease soil fertility. Heavy metals uptake by plants and successive accumulation in human tissues and bio magnifications through the food chain causes both human health and environment concerns (Singh and Kalamdhad, 2012). Several studies were carried out around the world for estimating the compost quality index, particularly the fertilizing and clean index by (Torkshvand, 2010; Saha et al., 2010; Bera et al., 2013; Dolui et al., 2014; Mandal et al., 2014 and Jalal, 2016). The rapid increases in application of compost to the soil specially in the nursery at 15 last years in Kurdistan region increasing the demand of composed, therefore a huge amount of several kinds of compost from

* Corresponding Author:
Dalshad Azeez Darwesh
E-mail: dalshad.darwesh@su.edu.krd

Article History:
Received: 07/01/2019
Accepted: 09/05/2019
Published: 10/09/2019
various countries imported to this region without quality control and prehistoric analyses, thus this study aimed to assesses the clean and fertilizing index of some common and widely used composts that imported to Erbil city, Kurdistan region-Iraq.

1. MATERIALS AND METHODS

1.1. Experimental design

This study was carried out for assessing the clean and fertilizing indices of diverse composts from various countries imported to Erbil city. The compost samples included 4 most common compost kinds (Indian C1, DutchC2, Estonia C3 and C4 locally produced) with five replications were bought in different local agrochemical market and shopping. The samples were dried at 65°C and then wet digested in H₂O₂ and H₂SO₄ acid (1/1, v/v) mixture using the producer of (Allen, 1974). The N content was measured by the distillation method of (Ryan et al., 2001) the P content was determined by the molybdenum blue colorimetric by spectrophotometric method, while the flame photometric method was used to determined K (Allen et al., 1974). The digested samples were used for determination the concentration of Cr, Cd, Pb, Cu, Ni and Zn by atomic absorption flame emission spectrophotometry and ICP (indicative coupled plasma) as described by (Pansu and Gautheyrou, 2006). The total Organic carbon and matter were determinate according to Walkly and Black method as described by (Richards, 1954).

\[ FI = \frac{\sum_{j=1}^{n} S_j W_j}{\sum_{j=1}^{n} W_j} \ldots (1) \]

Where Sᵢ is score value of analytical data and Wᵢ is weighing factor of the jᵗʰ fertility parameters as present in (Table 1). The clean index was also calculated using heavy metal concentrations (Zn, Cu, Cd, Pb, Ni, Cr). Score values were given to each analytical value of the heavy metals as per scheme mentioned in (Table 2). Clean index’ value was calculated by the following formula 2

\[ CI = \frac{\sum_{j=1}^{n} S_j W_j}{\sum_{j=1}^{n} W_j} \ldots (2) \]

where Sᵢ is score value of analytical data and Wᵢ is weighing factor of the jᵗʰ heavy metals as present in (table 2)

1.2 Statistical analysis

The experimental designed in completely randomized design (CRD). Data was statistically analyzed using SPSS version 24. All data expressed as mean value. The difference among the means of compost types were compared by applying Duncan multiple comparison tests at level of significant 5%. (Steele and Torrie, 1969).

Table 1: Criteria for weighing factor to fertility parameters and score value to compost. From (Saha et al., 2010).

| Fertility parameters | Score value(Sᵢ) | Weighting factor(Wᵢ) |
|----------------------|----------------|---------------------|
| TOC%                 | >20            | 15.1-20.0           | <9.1 5           |
| TN%                  | >1.25          | 1.01-1.25           | 0.51-0.20 3      |
| TP%                  | >0.60          | 0.41-0.60           | 0.11-0.20 3      |
| TK%                  | >1.00          | 0.76-1.00           | 0.26-0.50 1      |
| C:N                  | <10.10         | 10.1-15             | 20.1-25 >25 3    |

The Fertilizing index of the composts is computed using the formula 1 as described by (Saha et al., 2010):
RESULTS AND DISCUSSION

The characterization of compost and its comparison with FCO (Fertilizer Control Order) standard prescribed by Indian government and the standard of Hong kong are presented in (Table 3). The mean values of electrical conductivity revealed a significant difference among compost types as well as were lower than permissible limit of Indian standard which is <4 dS.m⁻¹. The total organic carbon is indicator of organic matter content of the compost, therefore the statistical analysis showed a significant different among the compost p≤0.05. The average value of total organic carbon (TOC) of both Dutch and Estonia were higher than the permissible limit of Indian standard which is >16, while the Percentage of TOC in local compost was 12.5% less than permissible limit of Indian standard. The TOC% was 16.5 for Indian compost is close to the permissible limit of Indian standard. The total organic matter (TOM) is important to compost quality parameters generally the total organic carbon values in all imported and local compost is greater than the permissible limit of Hong Kong standard which is ≥20, the higher percentage is 36.65 estimated from Dutch compost. Carbon and nitrogen ratios are a very important characteristics for estimation the compost maturity with respect to the organic matter and the nitrogen cycle, the carbon nitrogen ratio is directly related to the plant growth, because when the plant cultivated in soil amended with a compost have higher carbon nitrogen ratio the plant growth stunted and often yellow in color due to nitrogen deficiency arising out of nitrogen immobilization in that soil. Although the data analysis in this study refer to significant difference among the studied compost the carbon and nitrogen ratios are less than the permissible limit of Indian standard which is <20. The mean pH values of the composts were (6.63, 5.7, 6.01 and 7.15) for Indian, Dutch, Estonia and Local compost respectively, which were varied from the almost slightly acid and slightly alkaline, the pH vales of Dutch and Estonia were low as compared to FCO standard as recommended range 6.5-7.5, this result may related to the total organic matter% in both the Dutch and Estonia compost, because the organic matter decomposition released a organic acid such as humic acid which responsible on the pH lowering in compost. (Mandal et al., 2014)

The nitrogen, phosphorus and potassium are important macronutrients of plant growth, however play important role in compost quality determination. The statistical analysis in (Table 3) show a significant difference among the compost for nitrogen, phosphorus and potassium. The higher values (2.9, 3.28 and 0.5%) for nitrogen, potassium and phosphorus were recorded in Dutch, Indian and local compost respectively, the Nitrogen % is higher than permissible limit of Indian standard, however the K% was more than permissible limit of Indian standard except in Dutch compost was less, while the phosphorus% in all compost are lower than permissible limit of Indian standard except in local compost was equal to the 0.5min in the FCO standard.
Non essential trace metals detection in compost is great important for the quality, not only because these elements necessary for protect the soil and water resource from pollution, but also their impact on human health. In general the average concentration of all heavy metals were lower than permissible limit of Indian standard except the average concentration of Hg in all compost was exceeded permissible limit of German and Hong Kong standards as well as the concentration of Cd in Estonia and local compost was higher than permissible limit of Indian standard ,particularly its concentration in Estonian is very higher, thus its unsuitable to agriculture use, because the exceeded heavy metals content limited the use of compost to the agriculture land, the impact of contaminated of compost by pollutants on environmental health is varies cording to soil properties such as texture and the plant species.(Zhao et al., 2011).

The grades and marketability of compost depended largely on the fertilizer index and clean index, also these two indices provide the information about the quality of compost before its application for different purpose. The classification of compost based on marketability and use in accordance to fertilizer index (FI) and clean index (CI) are presented in (Table 4). The fertilizer index and clean index of imported and local compost are shown in (Fig1). The fertilizer index of compost was varied from 4.13 to4.47 where as the clean index was varied from 3.20 to 3.93, all compost has a fertilizer potential value >4 however the CI value of compost has medium heavy metals content, the statistical analysis in the present study indicated that imported and local compost has a good quality and proper for agriculture land.

| Compost types | Indian (C1) | Dutch (C2) | Estonia (C3) | Local production (C4) | FCO Indian standard | a Hong Kong Standard |
|---------------|------------|------------|--------------|-----------------------|---------------------|----------------------|
| Properties    |            |            |              |                       |                     |                      |
| EC dS.m⁻¹     | 0.80c      | 1.20b      | 1.10b        | 3.60a                 | <4.0                | --                   |
| TOC%          | 16.50b     | 21.31a     | 18.90b       | 12.50c                | 16min               | ≥12%                 |
| TOM%          | 28.38b     | 36.65a     | a32.51       | 21.50c                | --                  | ≥20%                 |
| C:N ratio     | 6:1        | 8:1        | 7:1          | 6:1                   | 20max               | ≤25                  |
| pH            | 6.63b      | 5.70c      | 6.01c        | 7.15a                 | 6.5-7.5             | 5.5-8.5              |
| N %           | 2.74b      | 2.90a      | 2.67b        | 1.97c                 | 0.5min              | ≥4%                  |
| K %           | 3.28a      | 0.90d      | 1.79c        | 2.61b                 | 1.0min              | ≥4%                  |
| P %           | 0.33c      | 0.36c      | 0.42b        | 0.50a                 | 0.5min              |                      |
| As            | 2.86a      | 0.83d      | 1.96b        | 1.52c                 | 15-25c              | ≤13                  |
| Cr            | 33.32b     | 43.21a     | 23.18c       | 36.38b                | 50                  | ≤201                 |
| Cd            | 1.80c      | 1.18c      | 28.40a       | 6.61b                 | 5                   | ≤3                   |
| Pb            | 4.30c      | 19.90a     | 12.60b       | 6.40c                 | 100                 | ≤150                 |
| Hg            | 14.50b     | 43.20a     | 3.90c        | 14.00b                | 1.0b                | ≤1                   |
| Cu            | 2.18b      | 2.32b      | 3.02a        | 2.11b                 | 300                 | ≤700                 |
| Ni            | 46.70a     | 39.90b     | 50.10a       | 33.70b                | 50                  | ≤62                  |
| Zn            | 27.20c     | 13.60d     | 41.90a       | 33.10b                | 1000                | ≤1300                |
| Clean index   | 3.87       | 3.93       | 3.20         | 3.27                  |                     |                      |
| Fertilizing index | 4.27     | 4.53       | 4.47         | 4.13                  |                     |                      |

a :General agriculture use, b:Germeny standard, c:Netherland standard

The same letter are not significantly different among mean value at 0.05probabilty levels
The result of heavy metal indicated that the compost contain higher concentration of Hg when compared to the permissible limit of heavy metals standard in USA, UK, Australia and all Europe countries that produce and use compost, this may be due to the present of some electronic or textile waste during preparation these compost, thus attention should focused on the heavy metals particularly the As and Hg which has great impact on the environmental health particularly the soil health.

Table 4: Classification of MSW compost for their marketability and use in different area. From (Saha et al., 2010).

| Class | Fertilizer index | Clean index | Quality control compliance | Remark |
|-------|------------------|-------------|-----------------------------|--------|
| A     | >3.5             | >4.0        | Complying for heavy metal parameters | Best quality. High manurial value potential and low heavy metal content and can be used for high value crops, such as in organic farming. |
| B     | 3.1-3.5          | >4.0        | Complying for heavy metal parameters | Good quality. Medium fertilizing potential and low heavy metal content. |
| C     | >3.5             | 3.1-4.0     | Complying for heavy metal parameters | Good quality. High fertilizing potential and medium heavy metal content. |
| D     | 3.1-3.5          | 3.1-4.0     | Complying for heavy metal parameters | Medium quality. Medium fertilizing potential and medium heavy metal content. |
| RU-1  | <3.1             | -           | Complying for heavy metal parameters | Not complying for heavy metal parameters. Restricted use. Should not be allowed to market. Can be used only for developing lawns/gardens (with single application), rehabilitation of degraded land. |
| RU-2  | >3.5             | >4.0        | Not complying for heavy metal parameters | Not complying for heavy metal parameters. Restricted use. Should not be allowed to market. Can be used only for developing lawns/gardens (with single application), rehabilitation of degraded land. |
| RU-3  | >3.5             | -           | Not complying for heavy metal parameters | Not complying for heavy metal parameters. Restricted use. Should not be allowed to market. Can be used only for developing lawns/gardens (with single application), rehabilitation of degraded land. |
2. CONCLUSIONS
According to the fertilizer index and clean index the compost that imported and that which produce locally had high fertilizer potential and serves as nutrients source as well as the clean index refers to the present of the heavy metals as medium concentration, while the result of present study indicated that the compost contain high concentration of Hg when compared to the permissible limit of heavy metals standard in USA, UK, Australia and all Europe countries that produce and use compost, thus attention should concentrated on this manner before marketing and use of these compost, thus the present study suggested that the clean index equation must involved the Hg metals because there toxicity and harmful to environment and human via soil pollution.

Conflict of Interest

There is no conflict of interest.

References

ALLEN, S. E. 1974. Chemical analysis of ecological materials. Black well scientific publication Osney Mead, Oxford. pp: 64-214

BERA, R., DATTA, A., BOSE, S., DOLUI, A. K., CHATTERJEE, A. K., DEY, G. C., BARIK, A. K., SARKAR, R. K., MAJUMDAR, D. and SEAL, A. 2013. Comparative evaluation of compost quality, process convenience and cost under different composting methods to assess their large scale adoptability potentials also complemented by compost quality index, International Journal of Scientific and Research Publications, 3(6): p.1–11.

DOLUI, A. K., BANERJEE, S., BERA, R., DATTA, A., SAHA, S. and SEAL, A. 2014. Assessment of novcom composting method as an effective biodegradation process and its impact on acid tea soils under various management practices, Journal of Recent Advances in Agriculture, 2(2): p.181–191.

JALAL S. Y. 2016. Applied Compost Quality indices for Assessment Different Composting Methods by Using Household Solid Waste, M.Sc thesis of College of Science, Salahaddin University-Erbil.

MANDAL, P., CHATURVEDI, M. K., BASSIN, J. K., VAI DyA, A. N. and GUPTA, R. K. 2014. Estimating the quantity of solid waste generation in oyo, Int J Recycl Org Waste Agricult., 3: p.133–139.

MORA, A. P.; BURGOS, P.; MADEJO’N. E.; CABRERA, R.; JAECKEL, P.; SCHLOTTER, M. 2006. Microbial Community Structure and Function in a Soil Contaminated By Heavy Metals: Effects of Plant Growth and Different Amendments. Soil biology and biochemistry, 38:327-341.

PANSU, M, and GAUTHEYROU, J. 2006. Hand book of soil Analysis, Springer-velocity Berlin Heidelberg, 3:1-38.

RICHARDS, L. A. 1954. Diagnosis and Improvement of Saline and Alkaline Soils United States Salinity Laboratory Staff, USA. Hand Book No.60

SAHA, J. K., PANWAR, N. and SINGH, M. V. 2010. An assessment of municipal solid waste compost quality produced in different cities of India in the perspective of developing quality control indices, Waste Management, 30: p.192–201.

SINGH, J. and KALAMDHAD, A. S. 2012. Reduction of Heavy Metals during Composting, International Journal of Environmental protection, 2(9):36-43.

STEEL, R.G.D and TORRIE, J.H. 1969. Principle and Procedures of Statistics. McGraw Hill, New York.481pp

TORKASHVAND, A. M. 2010. Improvement of compost quality by addition of some amendments, Australian Journal of Crop Science, 4(4): p.252–257.

ZH AO S.I.JAN and, DUO,I. 2011. EDTA associated phytoextraction of heavy metals by turf grass from municipal solid waste compost using permeable barriers and potential leaching risk. Bioresour, Tech. 102:621-626.