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Suitability of Urban Waste Composts for Organic Farming: - An Assessment through Quality Indices Based Approach in Kerala, India

C. Lathika and M.P Sujatha
Kerala Forest Research Institute, Peechi, Kerala , India

Abstract: *The objective of the study was to assess the nutrient potential and toxic contaminants in the urban waste composts produced through different composting methods in Kerala and to categorise them based on quality indices. A total of 11 compost samples were collected from various composting units of the State and the quality with respect to nutrient composition, heavy metal content, pesticide residue and pathogenic contaminations were assessed. The quality assessment based on the limit prescribed by FAI (2007) revealed that most of the samples were with the desirable brown to coffee brown colour, optimum content of moisture, EC and C:N ratio. But the optimum pH was observed only in the samples from Chalakkudy, Adat, Attingal and Sakthan. All the samples contained macro and micro nutrients, more than the minimum content prescribed. Even though, all the samples were free from pesticide residues, contamination with heavy metals was observed in all the samples except those from Sakthan. Samples from Laloor and Kodungallur were found contaminated with salmonella and ecoli and those from Kongadu and Perinthalmanna were having coliform. Based on the values developed on clean and quality indices, the composts only from Sakthan was found suitable for organic farming. The samples in the decreasing order of their quality were Kongad <Attingal <Chalakkudy<Perinthalmanna=Kozhikkode= Adat < Laloor< Vilappilsala< Palakkad< Kodungallur.*

Keywords: *Heavy metal, Nutrient potential, Pathogenic contamination, Quality index Urban Waste compost etc.*

I. Introduction

Rapid expansion of the cities/towns with massive migration of population from rural to urban centres, as well as considerable increases in per capita generation of wastes with each day, contribute continuous increase in the generation of municipal solid waste [1]. Normally, more than 90 per cent of these wastes are used for unscientific land filling or uncontrolled dumping on outskirts of towns and cities, which have serious environmental implications in global warming [2][3]. Existing municipal solid waste (MSW) management systems in India, which include storage, collection, transportation, segregation, processing and disposal of wastes is poorly developed [2][4]. The recent upsurge of interest in composting of various waste materials has resulted in development of regulations to control contaminants such as heavy metals [5].Compost quality refers to the overall state of the compost with regard to physical, chemical and biological characteristics. Quality assurance programs are instruments for product standardization and specification that improve consumer confidence and ultimately promote composting as a means for treatment of organic waste [6]. The quality of MSW composts depend mainly on source and nature of waste, the composting facility design, composting procedure and length of maturation etc[7]. A number of characteristics those determine compost quality are particle size distribution, moisture, organic matter and carbon content, concentration and composition of humus-like substances, content of essential nutrients, heavy metals, salinity, cation exchange capacity, water holding capacity, porosity, bulk density, inert contaminants, pathogens, state of maturity or stability etc. [8]. Currently no mechanisms are available for ascertaining the quality of composts, marketed as organic manure in Kerala, which in turn are harmful to public health, plants, soil and the environment. So the objective of this study was to analyze the urban waste compost available across the State of Kerala and derive the quality profile.

II. Materials and methods

2.1 Sample collection

Eleven urban waste compost samples were collected from various composting units operating under different local bodies in Kerala during 2011-2012. The samples were collected once from each unit by following the methods of US-EPA part 503 rule [9]. ie composite sample of several grab samples combined. The details pertaining to samples viz., place of collection, size of population, segregation status, type of composting etc. were also collected along with samples.

Table1. Basic informations on the compost samples collected for the study

Location	Population size (as per 2011 census)	Seggregation status	Methods of composting
Laloor(Thrissur corporation)	3,15,590	NS	Windraw
Kodungallur Municipality	94,883	NS	Windraw
Vilappilsala(Trivandrum corporation)	7,52,490	NS	Windraw
Chalakkudy municipality	1,14,901	NS	Windraw
Palakkad municipality	1,13,109	NS	Windraw
Adat Panchayath	5,721	PS	Vermi
Kongadu panchayath	14.808	PS	Windraw
Kozhikkode corporation	4,32,097	PS	Windraw
Perinthalmanna municipality	44,612	PS	Windraw
Attingal municipality	37,346	PS	Windraw
Sakthan (Thrissur corporation)	3,15,590	CS	Aerobic

NS - non segregated, PS-partially segregated, CS-completely segregated

2.2 Analytical methods

Content of moisture in the fresh samples were determined gravimetrically by estimating the loss in weight at 70 ^{0}C. Remaining portion of the samples were then dried at 70 ^{0}C, powdered, sieved through 4 mm sieve and kept ready for chemical analysis. The pH of the sample was determined in 1:10 sample water suspensions using digital type Cyber scan 510 pH meter[10]. Total organic carbon was determined gravimetrically by igniting the sample in a muffle furnace at 650 – 700 ^{o}C for 6 hrs. [11]. Samples were digested in sulphuric acid - salicylic acid- hydrogen peroxide mixture and the content of N (using Scalar autoanalyser), P (vanadomolybdate yellow colour) and K (flame photometry) were estimated. Content of Ca,, Mg, micronutrients (Fe, Cu, Mn and Zn) and heavy metals (Cd, Pb, Cr and Ni) in the above digested samples were determined using Atomic Absorption Spectrophotometer. (Varian 240).

Pathogenic microbes were assayed using pour plate technique. Selective media like Mc Conkey agar (Himedia, Technical data, M081B), PDA(Himedia, Technical data, M096), blood agar (Himedia, Technical data, M834), Thiosulphate citrate bile salts sucrose agar (Himedia, Technical data, M870A) and EMB agar (Himedia, Technical data, M317) were used to enumerate pathogenic microbes present in three different blocks of various samples. Plating was carried out for different dilutions from 10^{-2} to 10^{-8} of which dilutions of 10^{-4} and 10^{-5} were standardized for enumeration.

Pesticide residues with respect to organochlorides like alpha HCH, gama HCH/Linda, delta HCH, endosulfan-I, endosulfan-II, endosulfan sulphate, P,P'-DDE, P,P'-DDD, P,P'-DDT and organophosphorous like phorate, chlorpyriphos, malathion, parathion-methyl, quinaphos, profenophos, ethion were determined by chloroform extraction followed by injection to GC/ MS (Schimadzu model.)

2.3 Quality evaluation

Quality evaluation of composts was carried out based on the values generated for clean and quality indices.. The criteria for 'weighing factor' to quality parameters and score value' to compost are presented in Table 2.

Table 2. Criteria for assigning Score Value and Weighing factor

Parameters	Score values					Weighing factor
	5	4	3	2	1	
Moisture (%)	>25	22-25	20-21	18-19	<18	1
pH(1:10)	>9	8-9	6.1-7.9	5.5-6	<5.4	8
EC(dS/m)	>2	1.5-2	1.1-1.4	0.9-1	<0.9	2
OC (%)	>20	16-20	14-16	10-14	<10	10
N (%)	>1.4	1.2-1.4	1-1.2	0.7-1	<0.7	8
C:N ratio	>18	16-18	13-16	10-13	<10	8
P (%)	>1	0.8-1	0.6-0.8	0.3-0.6	<0.3	7
K (%)	>2	1.5-2	1.4-1	0.4-0.9	<0.4	6
Ca (%)	>3	2-2.9	1.2-1.9	0.5-1.1	<0.5	4
Mg (%)	>1.2	1-1.2	0.5-0.9	0.2-0.4	<0.2	4
Fe (ppm)	<0.3	0.3-0.7	0.8-1.2	1.3-1.5	>1.5	3
Cu(ppm)	<135	135-150	151-200	201-275	>275	3
Mn(ppm)	<150	151-250	251-300	301-400	>401	3
Zn(ppm)	<85	86-100	101-200	201-300	>301	3
Cd(ppm)	<2	2-3.2	3.2-5	5.1-6.2	>6.2	10
Pb(ppm)	<90	91-150	151-250	251-350	>351	8
Cr(ppm)	<4.5	4.6-14.5	14.6-24.5	24.6-50	>50	8
Ni(ppm)	<4	4.1-24	25-50	51-75	>76	5

The weighing factor was maximum for organic carbon due to its important role in improving soil quality. Weighing factor for other parameters varied from 1 to 10, depending on their potential in improving soil health. Quality Index value was calculated using the formula

QI= $\frac{\sum_{n}^{i=1} SiWi}{\sum_{n}^{i=1} Wi}$ Where Si is the score value and Wi is the weighing factor of the ith quality parameter of analytical data.

For clean index , the weighing factor was 10 (maximum) for Cd due to its high mammalian toxicity, median to low phyto toxicity potential and as a functional role to the organism. For other heavy metals, weighing factor varied from 1 to 10. The clean index value of compost was calculated using the following formula .The higher the value for clean index (CI), the lesser the contamination due to heavy metal.

CI= $\frac{\sum_{n}^{j=1} SjWj}{\sum_{n}^{j=1} Wj}$ Where Sj is the score value and Wj is weighing factor of the jth heavy metal of the analytical data.

III. Results and discussion

The details on different approaches adopted for composting of urban wastes in various composting units of the State and the quality of composts thus produced with respect to physico-chemical characteristics, nutrient composition, biological and heavy metal contaminations are described in the following paragraphs

3.1 Method of composting

The closer examination of composting process at various sites during sample collection revealed that pre-processing of wastes were not followed at five sites namely Laloor, Kodungallur, Vilapilsala, Chalakkudy and Palakkad. At all these sites, it was found that non-segregated wastes were heaped and left for several months without turning for decomposition. But in the other sites viz., Adat, Kongadu, Kozhikkode, Perinthalmanna and Attingal non-biodegradable wastes like plastics, rubber, metals etc. were manually removed prior to composting (termed as 'partially segregated'). At one site, namely Sakthan, only biodegradable wastes were collected from individual households and vegetable markets, shredded and ground before composting using microbial innoculum. In the composting yards at ,Palakkad, Laloor, Attingal, Chalakkudy and Kozhikkode microbial cultures and cow dung were being used as innoculum. Post-processing methods mainly involved air-drying of the composts followed by sieving, either mechanically or manually to remove bigger sized inert particles.

3.2. Physical characteristics

Colour and moisture content in the composts were the important physical parameters tested in this study (Table 3). Most of the compost samples in general were with acceptable colour varying from brown to coffee brown, except those from Vilappilsala, which was ash in colour. Variation in colour is normally due to the differences in the type of raw materials and process of composting methods. The heat generated during the initial period of composting is believed to have profound effect on the colour of the compost produced. The temperature of the heat thus generated again depend up on the type of feed stock and activity of micro organisms.

Content of moisture in the compost samples (Table 3) varied from 918.3per cent to 27.1 per cent with a mean value of 22.7per cent. Highest moisture per cent was in Laloor (27.1per cent) and lowest in those from Vilappilsala (18.3 per cent). According to the [12] it is desired to have 15-25per cent moisture in the finished products. Most of the samples except those from Laloor, Kodungallur and Perinthalmanna were within the prescribed limit. (Table 3). Composts with less moisture contents may not have been fully stabilized or may have been stored for long periods leading to moisture loss [13]. While excessively dry composts are often dusty and unpleasant to handle. Compost with too high moisture content becomes too clumpy and increase transportation cost.

Table 3. Physical and chemical characteristics of the urban waste compost produced at different composting units in Kerala.

Location	Colour	Moisture (%)	pH	EC(dS/m)	C(%)	C:N
Laloor	Slightly Brown	27.1±0.37	8.5±0.03	0.53±0.01	11.50±1.01	16.60±0.82
Kodungallur	Slightly brown	26.2±0.24	9.1±0.15	1.85±0.05	11.43±0.35	13.13±0.67
Vilappilsala	Ash colour	18.3±0.19	8.4±0.03	0.44±0.01	13.20±0.15	13.87±0.67
Chalakkudy	brown	23.2±0.39	7.3±0.03	2.03±0.07	11.33±0.23	14.03±0.32
Palakkad	brown	19.0±0.32	8.2±0.18	0.72±0.03	12.57±0.58	11.23±0.09
Adat	Slightly brown	23.3±0.23	7.4±0.03	1.28±0.04	15.33±0.30	13.07±1.17
Kongadu	Slightly ash	24.4±0.27	8.1±0.09	0.44±0.01	20.47±0.12	18.73±0.62

Kozhikkode	Coffee brown	25.4±0.2	8.2±0.09	0.41±17.37	17.37±0.26	15.97±0.20
Perinthalmanna	Coffee brown	21.0±0.19	7.8±0.09	0.76±0.01	14.70±0.35	13.50±0.83
Attingal	Coffee brown	19.7±0.26	7.1±0.06	0.80±0.01	16.23±0.17	15.67±0.62
Sakthan	Coffee brown	23.7±0.90	7.3±0.12	0.43±0.01	15.80±0.90	11.43±0.58

3.3. Chemical characteristics

Chemical characteristics of the samples with respect to pH, EC, organic carbon and C:N ratio were assayed and the data are given in Table 3.

A considerable variation in pH was observed between the samples and the values ranged from 7.1 to 9.1 with an overall mean value of 8.1. The highest pH was seen in the samples from Kodungallur (9.1) and the lowest in Attingal (7.1). The samples from Chalakkudy, Adat, Attingal and Sakthan were within the limit (6.5 to 7.5) prescribed by FAI (2007). Extra ordinary high values of pH noted in some samples might be due to improper method of composting. However, considering the acidic nature of the soils of Kerala, the matured composts with pH more than 6.5 are beneficial for improving the chemical condition of the soil.

Electrical conductivity of the samples varied widely from 0.44-2.03 dS/m with a mean value of 1.23 dS/m. Since all the samples were within the prescribed limit of FAI (2007) ie , $\leq$ 4 dS/m, they are found suited for organic farming under Kerala condition.

The content of carbon in the compost samples varied from 11.3 to 20.5 per cent with mean of 15.9 per cent .According to FAI (2007), carbon content of the compost sample should be $\geq$16 per cent. In this study, only three samples, those from Kongadu, Kozhikkodu and Attingal were within the prescribed limit.while the remaining were below the limit.

Carbon to nitrogen ratio (C:N) is considered as a chemical indicator for compost maturity with respect to organic matter and N cycling. In the present study, C:N ratio in the compost samples ranged from 11.2:1 to 18.7:1 with a mean value of 14.5:1 (Table 3). The highest C:N ratio was recorded in the samples from Kongadu(18.7:1) and lowest in those from Palakkad(11.2:1). C: N ratio of all the samples analysed in this study were within limit of FAI, (2007). Ideal compost feedstock mixtures are supposed to have an initial C:N ratio of about 30:1, decreasing to less than 20:1 as composting process proceeds [14].

3.4 Nutrient potential

Nutrient supplying power of the composts were evaluated based on the content of essential macro and micro nutrients needed for the growth and development of plants.

3.4.1 Macro nutrients

Nitrogen, phosphorus and potassium, being the major nutrients taken by the plants from soil are considered as important quality parameters of composts. Total N, P and K in the compost samples varied from 0.61 per cent to 1.4 per cent, 0.19 per cent to 1.24 per cent and 0.21 per cent to 2.25 per cent t respectively (Table 4). Highest value of N was observed in Sakthan compost (1.38 per cent) and lowest in Laloor (0.69 per cent). According to FAI (2007), the content of N in composts must be $\geq$0.5 per cent and the data generated in this study indicated that all the samples were with more than the prescribed limit of this nutrient. With respect to P, its content was highest in the sample from Chalakkudy (1.18 per cent) and the lowest in those from Kodungallur (0.25 per cent). Generally in all the samples, the content of P was > 2 per cent, the limit prescribed by FAI (2007). As in the case of P, samples from Chalakkudy contained higher content of K (2.23 per cent) and those from Kodungallur were poor (0.26 per cent) in this nutrient. In general, most of the samples except those from Chalakkudy, Perinthalmanna, Attingal and Sakthan were with relatively poor content of this nutrient, the limit prescribed by FAI (2007). The higher content of K in some of the samples is supposed to be the contribution from the feed stocks such as wastes from banana and flowers, containing relatively higher reserve of this nutrient.

With respect to the secondary nutrients such as calcium and magnesium, the values ranged between 0.28-3.33 per cent and 0.14- 1.35 per cent respectively. Samples from Chalakkudy were with highest content of Ca and Mg and those from Kozhikkode contained lowest level of these nutrients(Table 4). Since FAI (2007) has not prescribed any limit for the above nutrients, it is not possible to make any remarks on their adequacy in these samples.

Table 4. Composition of major nutrients in the urban waste composts produced at different composting units in Kerala.

Location	Nutrients (per cent)				
	N	P	K	Ca	Mg
Laloor	0.69±0.05	0.79±0.11	1.23±0.08d	2.04±0.03	0.67±0.05
Kodungallur	0.87±0.03	0.25±0.05	0.26±0.07	1.19±0.07	0.32±0.02

Vilappilsala	0.96±0.04	0.73±0.07	0.61±0.14	3.06±0.10	0.20 ±0.01
Chalakkudy	0.81±0.03	1.18±0.06	2.23±0.29	3.33±0.15	1.30 ±0.03
Palakkad	1.12±0.06	0.54±0.03	0.56±0.10	1.85±0.05	0.88 ±0.05
Adat	1.19±0.08	0.34±0.05	0.73±0.04	1.44±0.18	0.57 ±0.02
Kongadu	1.09±0.04	0.44±0.08	0.56±0.09	0.45±0.04	0.30 ±0.03
Kozhikkode	1.09±0.00	0.80±0.10	0.59±0.08	0.33±0.02	0.18 ±0.02
Perinthalmanna	1.09±0.04	0.72±0.03	0.83±0.14	0.55±0.04	0.19 ±0.01
Attingal	1.04±0.05	1.10±0.04	1.43±0.31	0.46±0.04	0.19 ±0.01
Sakthan (Thrissur)	1.38±0.01	0.87±0.03	0.98±0.08	0.42±0.07	0.19 ±0.00

3.4.2 Micronutrients

Content of micronutrients viz., Fe, Cu, Zn and Mn in the compost samples (Table 5) ranged between 0.25-1.52 per cent; 147.8 - 288.3 ppm; 87.6 -328.6 ppm and 132.3-441.1 ppm respectively. The data in general indicated a relatively high reserve of micronutrients in all the samples analysed.

Table 5. micro nutrients in the urban waste compost produced at different composting units of Kerala.

Location	Fe (%)	Cu (ppm)	Mn (ppm)	Zn (ppm)
Laloor	0.84±0.02	164.57±2.25	435.50±13.96	119.27±5.20
Kodungallur	0.92±0.07	188.30±1.81	249.97±2.05	113.70±5.3
Vilappilsala	0.51±0.02	132.13±2.36	383.00±3.74	87.63±1.12
Chalakkudy	1.71±0.19	175.20±3.94	417.43±4.91	328.60±9.32
Palakkad	0.49±0.02	186.90±2.31	295.93±3.23	87.80±0.99
Adat	0.50±0.02	288.27±5.60	441.07± 3.34	110.50±2.40b
Kongadu	1.09±0.03	273.63±8.32	347.20±2.80	243.30±4.37
Kozhikkode	0.83±0.02	158.40±10.63	132.29±1.72	317.50±6.51
Perinthalmanna	1.52±0.03	192.63±4.33	326.78±3.16	174.20±2.57
Attingal	0.44±0.04	234.43±8.42	210.67±0.59	101.73±1.50
Sakthan	0.25±0.03	147.83±5.87	267.80±7.80	187.13±5.21

3.5. Heavy metal contamination

Contamination of composts with heavy metals is considered as an undesirable quality parameter. In the present study content of Cd, Pb, Cr and Ni ranged between 1.8 -7.8 ppm; , 75.6 - 657.5 ppm, 4.5 - 100.5 ppm and 3.9 - 92.5 ppm respectively and the corresponding mean values were 5.08 ppm,, 255.4 ppm , 44.8 ppm and 43.8 ppm. In the case of Cd, the highest value was in the sample from Laloor (7.37 ppm) and lowest in those from Sakthan (2.27 ppm). According to FAI(2007), the minimum prescribed limit of Cd was 5ppm. But the samples from Laloor, Kodungallur, Vilappilsala, Chalakkudy, Palakkad and Kongadu contained more than the maximum limit while those from Adat. Kozhikkode ,Perinthalmanna, Attingal and Sakthan were within the limit. (Table 6).

Table 6. Heavy metal content of the municipal solid waste compost produced at different composting units in Kerala.

Location	Heavy metal content, ppm			
	Cd	Pb	Cr	Ni
Laloor	7.37±0.26	326.70±16.4	77.40±7.73	85.57±3.78
Kodungallur	6.33±0.32	606.07±25.82	60.6±4.66	70.70±0.49
Vilappilsala	5.83±0.13	210.00±12.73	99.65±0.54	68.80±3.12
Chalakkudy	5.53±0.18	360.37±8.63	48.03±0.92	68.40±0.87
Palakkad	6.63±0.12	278.13±2.08	43.30±1.80	52.77±0.55
Adat	3.77±0.67	109.30±9.57	32.50±1.40	18.63±0.66
Kongadu	5.40±0.40	85.63±5.12	35.70±4.38	12.73±1.01
Kozhikkode	4.60±0.64	384.02±32	40.83±0.38	38.76±0.64
Perinthalmanna	4.47±0.28	241.48±58.04	38.79±0.39	47.01±1.11
Attingal	3.73±0.29	116.30±19.11	10.83±0.29	14.57±0.54
Sakthan	2.27±0.42	91.83±2.40	4.64±0.09	4.40±0.40

The content of Pb was highest in Kodungallur (606.07 ppm) and lowest in Kongadu (85.63 ppm). According to FAI(2007) the prescribed maximum limit of Pb was 100 ppm. But most of the samples, except those from Kongadu and Sakthan were with higher level of this metal (Table 6) In the case of Cr, the samples from Laloor, Kodungallur and Vilappilsala were with more than the permissible limit. Content of Ni was highest in the sample from Laloor (85.57 ppm) and lowest in those from Sakthan (4.4ppm). According to the FAI(2007), the permissible limit of this metal was was 50 ppm, and the samples from Laloor, Kodungallur, Vilappilsala, Chalakkudy and Palakkad exceeded the permissible limit. Segregation of wastes before composting is supposed to reduce the heavy metal content in the composts. The data given above on the content of heavy metals in the compost samples revealed improper seggregation of urban wastes in various composting units of the State except at Sakthan.

3.6 Pesticide residues

Pesticide residues of organochlorides like alpha HCH, gama HCH/Linda, delta HCH, endosulfan-I, endosulfan-II, endosulfan sulphate, P,P'-DDE, P,P'-DDD, P,P'-DDT and organo phosphorous like phorate, chlorpyriphos, malathion, parathion-methyl, quinaphos, profenophos, ethion were in all the urban waste compost samples. Results revealed that all the samples were with the non detectable level of above pesticides.. According to the FAI (2007) the limit value was 0.01mg/kg.

3.7. Pathogenic contamination

The compost samples collected from various sites were subjected to enumeration of pathogenic microorganisms. Salmonella was detected (>10^3 cfu/g) in the compost samples from Laloor and Palakkad. Total coliform was detected (>10^3 cfu/g) in five e locations, namely, Palakkad, Kongadu, Laloor, Kodungallur and Perinthalmanna. According to the FAI (2007), the good compost should be absent in pathogens.

Table7. Pathogenic contamination of urban solid waste compost produced at different composting units in Kerala

Sample Location	Pathogenic contamination >10^3 cfu/g			
	E.coli	Salmonella	Vibrio sps.	Fungi
Laloor	$2.5x10^3$	$2.57x10^3$	NG	$1.03X10^3$
Kodungallur	$1.8x10^3$	NG	NG	NG
Vilappilsala	NG	NG	NG	NG
Chalakkudy	NG	NG	NG	NG
Palakkad	$1.78x10^3$	$1.2x10^3$	NG	NG
Adat	NG	NG	NG	NG
Kongadu	$1.2x10^3$	NG	NG	$4X10^3$
Kozhikkode	NG	NG	NG	$2.13X10^3$
Perinthalmanna	$1.8x10^3$	NG	NG	NG
Attingal	NG	NG	NG	NG
Sakthan	NG	NG	NG	NG

3.8 Evaluation of compost quality

Quality of urban composts for organic farming was evaluated based on the values developed for clean and quality indices. The Quality index value varied from 3.4 to 2.3, high at Sakthan and Kongadu(3.4) and followed by Attingal and low value was seen in Kodungallur. The samples in the decreasing order of their quality were Kongad <Attingal <Chalakkudy<Perinthalmanna=Kozhikkode= Adat < Laloor< Vilappilsala< Palakkad< Kodungallur. Clean Index value varied from 1.2 to 4.4. High value value was in Sakthan(4.4)followed by

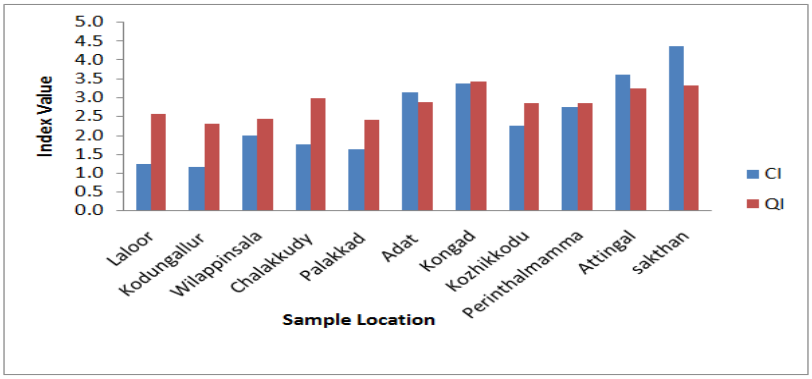

Fig.1. Variation of Quality index and Clean index of the compost samples.

Attingal. But the lowest value was seen in Laloor, Kodungallur Followed by Palakkad and Chalakkudy.The high value representing good quality compost and it is used for agriculture soil.Compost samples from Kongadu had high quality index but the Cd content was exceeds the level of FAI(2007) value.

IV. Conclusion

Based on the results of the study, it is concluded that the urban composts only from Sakthan was found suitable for organic farming. Even though all the samples satisfy the minimum requirement of nutrients, most of them are found contaminated with heavy metals. The samples in the decreasing order of their quality were Kongad <Attingal <Chalakkudy<Perinthalmanna=Kozhikkode= Adat < Laloor< Vilappilsala< Palakkad< Kodungallur. The study suggests proper method of segregation and composting of urban wastes for quality improvement of composts.

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