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Characteristics of nutrient content in domestic sewage water as a source of nutrient for vegetable production alongside railway track of Mumbai

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Abstract
Sewage water contain essential plant nutrients required for plant growth, which are within permissible limits are suitable for irrigation purpose as per norms of different agencies. The present study was carried out to assess different physico chemical properties of sewage water which was collected from alongside railway track of Mumbai during *kharif* and *rabi* season of year 2016-17. The laboratory work was carried out in Department of Soil Science and Agricultural Chemistry, Dr. PDKV, Akola. As per analysis discovered that, characteristic of sewage water *viz.* BOD, COD, pH, EC, CO_3, NO_3-N, PO_4-P, K, exchangeable Ca^{2+}, Mg^{2+}, Na and SO_4-S were studied. Sewage water used for irrigation to vegetable crops alongside Mumbai local railway track had BOD (41.25 mgL^{-1}), COD (48.23 mgL^{-1}), pH (7.02), CO_3 (Nil), K (17.87 mgL^{-1}), exchangeable Ca (54.62 mgL^{-1}), exchangeable Mg (28.05 mgL^{-1}), SO_4-S (656.29 mgL^{-1}) were within the prescribed limits whereas, EC (0.99 dS^{-1}), NO_3-N (25.84 mgL^{-1}), HCO_3 (15.18), Na (3.96 mgL^{-1}) beyond prescribed limits of FAO (1985), however PO_4-P (57.82 mgL^{-1}) as per Indian standard (1982).

Keywords: Domestic sewage, nutrient content, Mumbai, railway track

Introduction
With the increase in population the industrialization and urbanization have also increased promptly. Due to industrialization and advance techniques in agriculture, the essential things are get by peoples, but simultaneously we should defend the health of people and reserve the environment. The population rise has not only increased the fresh water demand but also increased the volume of wastewater generated. Therefore such indiscriminate discharge of sewage water is a cause for soil and groundwater pollution. Therefore, there is need to preserve and protect fresh water and to use the water of lower quality for irrigation. In India due to lack of sewage treatment plants the sewage water is directly added in agricultural lands or disposed off in nearby water bodies. Because the sewage water or effluent coming from any source like industry or domestic sewage may containing different nutrients which are above the prescribed limits are harmful for crops, humans and animal which are consume it. In agriculture practices, the irrigation water quality is believed to have an effect on the soil characteristics, crops production and management of water Shainberg and Oster (1978) [14].

Material and Methods
The sewage water samples were collected in 1000 ml capacity plastic bottles from the defined place of nalas or gutter near to Central, Western and Harbour railway track of Mumbai and Navi Mumbai by grab sampling method. Placed the samples in appropriate labeled bottles and refrigerated at 4 ^{0}C. The samples thus collected were taken to laboratory for further analysis, (American Public Health Association, 1985) [2]. The experiment was conducted during two seasons, *viz. kharif* and *rabi* in the year of 2016-2017. The nalas which was flows through Mumbai, Mumbai suburban city's and Navi Mumbai near railway track carries domestic sewage as well as industrial waste water. Which may or may not be treated and directly discharge into the nalas or gutter from all over city's of Mumbai. The pH of sewage water was measured by potentiometric method, EC by conductometric method, Biological oxygen demand by Winkler titration method, Chemical oxygen demand Reflux method, exchangeable calcium and magnesium determined by Versenate titration method, Carbonates and Bicarbonates were determined titrimetricaly as per procedure given by Richards (1954) [13].

Nitrate nitrogen (NO_3-N) by Reduction method. The phosphorous by Vanadomolybdate phosphoric acid (colorimetrically) method. Potassium and Sodium was estimated by flame photometric method as per methods described in American Public Health Association (1985) [2] and Sulphate by turbidimetric method.

Results and Discussion

BOD and COD of Sewage Water

The BOD of sewage water alongside the Mumbai local railway track was ranged from 28.70 to 52.20 mgL^{-1} with mean value of 41.25 mgL^{-1}, which was under safe limit prescribed by FAO (1985) for irrigation water i.e. 100 mgL^{-1}. Lower BOD of Mumbai sewage water might be due to low content of organic residues in industrial effluent and high urbanization. The COD of sewage water was ranged from 38.40 to 58.80 mgL^{-1} with mean value of 48.23 mgL^{-1}, which was also under safer limits prescribed by Indian standards (1982) for irrigation water i.e. 500 mgL^{-1}. In general it was noticed that, BOD and COD of the sewage water use for irrigation alongside Mumbai local railway track was under permissible limit might be due to almost all severage lines / nallas carry domestic sewage with an organic and chemical residues. Similar results were also reported by Mitra and Gupta (1999) [8] for Calcutta 34.00 to 78.00 mgL^{-1} and Masthiholi (2005) for Hadapsar area of Pune city 69.60 mgL^{-1}. The lower BOD was also noticed by Prasad Rao (2003) [11].

pH and EC of Sewage Water

pH of sewage water alongside the Mumbai local railway track was ranged from 6.29 to 7.75 with a mean value of 7.02, In general sewage water was neutral in reaction and which was within safe limit i.e. 6.00-8.50 as given by the United States Salinity Laboratory Staff (1954) as well as safer pH range 6.50-8.50 as given by FAO (1985) for irrigation water. The slightly acidic to slightly alkaline nature of Mumbai sewage water may be due to lower content of organic residues. Whereas, EC was ranged from 0.25 to 2.95 dSm^{-1} with mean value of 0.99 dSm^{-1}. Which was quite high and observed to exceed the toxic limit 0.6 dSm^{-1} as per the United States Salinity Laboratory Staff (1954) and 0.7 dSm^{-1} as per FAO norms (1985). In general sewage water alongside the Mumbai railway local track was unsafe for the irrigation purpose.

CO_3, HCO_3 and Na content in Sewage Water

CO_3 content in sewage water alongside the Mumbai local railway track was nil or not detected might be due to carbonates can only exist if the pH of the water exceeds 8.3. However, HCO_3 content in sewage water ranged from 6.00 to 25.00 meL^{-1} with mean value of 15.18 meL^{-1}, which were very very high than the recommended level of 1.50 meL^{-1} as given by FAO (1985). Higher content of HCO_3 in the sewage mostly due to detergent and food residues and their breakdown products coming from residential area of Mumbai. However, Na content was ranged from 1.76 to 6.56 meL^{-1} with mean value of 3.96 meL^{-1}, which was little beat higher than 3.00 meL^{-1} as per prescribed limits given by FAO (1985). Similar results was also reported by Mastiholi (2005) [7] for Manjari and Hadapsar villages of Pune, Varkey (2014) [17, 18] for Hubli city of Karnataka and Singh *et al*. (2012) [12] for municipal domestic sewage water of Maharajbag.

Primary nutrient content in sewage water

The NO_3-N content in sewage water of Mumbai was ranged from 6.16 to 61.60 mgL^{-1} with the mean value of 25.84 mgL^{-1}, which was exceeded the permissible limit 5.00 mgL^{-1} given by FAO (1985). These might be due to continuous mineralization of suspended organics in the effluents. The PO_4-P ranges from 17.68 to 124.79 mgL^{-1} with mean value 54.82 mgL^{-1}, which was beyond the prescribed limits of 5.00 mgL^{-1} as given by Indian standards (1982), From data it can be revealed that, content of phosphorus in sewage water were irrespective of place and period of sampling which may be due to use of large amounts of detergents by the households in domestic water of Mumbai city. Whereas K content ranged from 2.73 to 53.43 mgL^{-1} with mean value of 17.87 mgL^{-1}. The present results of nitrogen, phosphorous and potassium content in sewage water was in agreement with findings of Vazhacharickal *et al*. (2013) [19] at Mumbai near railway track, Ramu meena (2015) [12] for Western Delhi, Mojiri *et al*. (2011) [9] for Iran, Varkey (2014) [17, 18] at Hubli city of Karnataka and Alghobar *et al*. (2014) [1] for south western of Mysore city.

Table 1: Characteristics of sewage irrigation water alongside Mumbai local railway track

Sr. No.	Railway track	Name of location	Mean of *kharif* and *rabi* season (2016-17)												
			(mgL^{-1})			(dSm^{-1})	(meL^{-1})			(mgL^{-1})					
			BOD	COD	pH	EC	CO_3	HCO_3	Na	Ca	Mg	NO_3-N	PO_4-P	K	SO_4-S
1.	Central line	Kalyan	46.60	50.40	7.10	0.55	BDL	10.00	1.76	20.54	60.00	15.68	28.43	13.46	598.08
2.		Thakurli-I	39.80	47.20	6.95	0.65	BDL	6.00	2.59	54.00	32.40	10.64	42.45	7.80	802.43
3.		Thakurli-II	39.60	52.80	6.77	0.55	BDL	10.00	2.89	46.00	22.80	6.16	34.73	7.22	793.10
4.		Kalwa	36.00	50.40	7.14	0.75	BDL	23.00	2.91	64.00	28.80	17.36	36.02	7.41	798.50
5.		Bhandup	44.60	51.40	7.09	0.80	BDL	18.50	2.65	50.00	60.00	10.08	41.87	2.73	746.96
6.		Kanjurmarg	44.80	58.00	6.85	0.95	BDL	18.50	4.09	38.00	26.40	35.28	27.43	18.92	590.73
7.		Ghatkopar	43.40	58.80	6.81	1.00	BDL	14.50	4.15	48.00	16.40	19.60	61.75	20.54	598.08
8.		Vikhroli	45.20	51.20	7.00	0.85	BDL	14.00	3.80	56.00	26.40	36.96	24.62	11.51	518.30
9.		Kurla	46.80	44.80	7.02	1.15	BDL	20.00	4.65	34.00	15.60	23.52	50.17	17.16	626.40
10.		Sion	45.00	46.00	7.09	1.10	BDL	20.50	5.13	78.00	39.60	14.96	29.59	16.58	769.52
11.	Western line	Mahim-I	50.00	46.40	7.19	0.60	BDL	16.00	2.78	56.00	14.00	17.36	31.72	21.65	626.64
12.		Mahim-II	52.20	51.20	6.98	0.25	BDL	19.50	3.98	40.00	7.20	8.60	97.77	14.24	322.56
13.		Malad-I	48.40	53.20	6.66	1.45	BDL	18.00	6.02	44.00	27.60	21.88	124.79	42.32	579.50
14.		Malad-II	47.20	49.60	7.05	1.45	BDL	25.00	5.15	42.00	20.40	54.32	109.35	53.43	721.62
15.		Malad-III	42.20	49.60	6.92	0.75	BDL	20.00	3.37	44.00	4.80	28.00	38.59	12.48	538.68
16.		Dahisar-I	45.40	47.60	6.97	1.05	BDL	19.50	4.67	46.00	13.20	61.60	90.05	28.86	455.52
17.		Dahisar-II	49.80	46.40	6.31	0.75	BDL	14.00	4.22	44.00	5.40	10.64	54.03	13.26	417.60
18.		Kandivali-I	47.40	46.40	7.04	0.80	BDL	14.00	3.46	38.00	19.20	31.36	66.90	23.21	512.48
19.		Kandivali-II	38.80	48.80	6.93	0.95	BDL	15.50	3.96	48.00	22.80	35.28	108.06	26.52	692.88

20.		Mera road	28.70	47.60	7.75	2.10	BDL	16.50	5.80	40.00	31.20	60.48	79.76	34.52	955.75
21.	Harbour line	Airoli	40.00	46.80	7.12	1.30	BDL	12.50	4.82	62.00	14.40	22.40	55.32	20.48	588.48
22.		Rabale	44.00	47.60	7.04	0.80	BDL	14.50	3.19	36.00	28.80	39.76	23.15	17.36	437.56
23.		Ghansoli	38.60	44.40	6.29	1.15	BDL	19.00	4.32	78.00	32.40	21.84	23.15	10.53	697.92
24.		Koparkhairne	32.90	49.20	7.37	0.80	BDL	11.00	3.80	52.00	20.40	11.21	87.48	11.51	625.46
25.		Turbhe	36.00	40.80	7.26	0.80	BDL	13.50	2.98	50.00	13.20	58.88	88.77	13.65	774.00
26.		Juinagar	43.10	38.40	6.58	0.95	BDL	9.50	4.58	48.00	11.80	15.68	54.03	16.97	781.92
27.		Nerul	30.25	44.00	7.16	2.95	BDL	12.50	5.15	60.00	25.20	24.64	24.44	13.46	836.00
28.		Belapur	30.20	44.00	7.04	0.65	BDL	9.50	1.97	56.00	15.60	31.36	17.68	8.39	585.48
29.		Kharghar	31.00	50.00	7.58	1.05	BDL	8.00	6.56	212.00	165.00	17.92	47.60	15.41	879.65
30.		Khandeshwar	29.40	44.00	7.50	0.80	BDL	12.50	3.43	54.00	20.40	11.76	45.03	14.43	816.97
Range			28.70-52.20	38.40-58.80	6.29-7.75	0.25-2.95		6.00-25.00	1.76-6.56	20.54-212.00	4.80-165.00	6.16-61.60	17.68-124.79	2.73-53.43	322.56-955.75
Mean			41.25	48.23	7.02	0.99		15.18	3.96	54.62	28.05	25.84	54.82	17.87	656.29

Secondary nutrient content in sewage water

The exchangeable Ca content in sewage water of Mumbai was ranged from 20.54 to 212.00 mgL^{-1} with mean value of 54.62 mgL^{-1}, which was under the prescribed limit of 400.00 mgL^{-1} given by FAO (1985), while exchangeable Mg was ranged from 4.80 to 165.00 mgL^{-1} with mean value of 28.05 mgL^{-1}, which were below recommended level 60.00 mgL^{-1} as given by FAO (1985) [3]. However, sulphur content in sewage water was ranged from 322.56 to 955.75 mgL^{-1} with mean value of 656.29 mgL^{-1}, which was below permissible limits as given by FAO (1985) [3] i.e. 1000.00 mgL^{-1}. The content of sulphur in Mumbai sewage water may be due to dissolve human and livestock excreta and sulfates are found in most water supplies. Sufficient sulfur is normally available in domestic wastewater in the form of organic sulfides such as mercaptans, and disulfides for the production of odorous gases by anaerobic and facultative bacteria. Similar values of secondary nutrients was observed by Kharche *et al*. (2011) [11] at Ahmednagar disctrict. Omron *et al*. (2012) [10] for AlHassa area of Saudi A*rabi*a and Ladwani *et al*. (2012) [6] for domestic waste water of Nagpur (India) 1.60 mgL^{-1}.

Conclusion

From the results, it can be concluded that sewage irrigation is found to be beneficial and cheap as per source of nutrients for crop production but, it was not beneficial as per health of human beings because sewage water of Mumbai contains some nutrients which are in high amount may also found in vegetables which are cultivated alongside railway tack of Mumbai.

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