International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2019; 7(2): 551-555

Received: 19-01-2019
Accepted: 23-02-2019

Bisweswar Gorain
ICAR-Central Soil Salinity Research Institute, RRS Bharuch, Gujarat, India

Srijita Paul
Department of Agronomy, Bidhan Chandra Krishi Viswavidyalaya, Nadia, West Bengal, India

Correspondence
Bisweswar Gorain
ICAR-Central Soil Salinity Research Institute, RRS Bharuch, Gujarat, India

Water quality in urban lakes of Bengaluru, Karnataka due to idol immersion activities

Bisweswar Gorain and Srijita Paul

Abstract
Deterioration of water quality in the urban lakes of Bengaluru, Karnataka due to anthropogenic activities, has been an alarming issue in the recent times. Immersion of idols coated with synthetic paints and dumping of organic wastes in the lakes as part of religious rituals, is adversely affecting the lake water quality. These activities contaminate the water with alkali, alkaline earth metals and heavy metals, thereby reduce the level of dissolved oxygen, increase the hardness of water and therefore, threaten aquatic ecology. In this context, periodic analysis of Yelhanka and Yediyur lake water were undertaken to investigate the effect of idol immersion activities on the water quality. In Yelhanka lake water, the maximum concentrations of calcium and magnesium were recorded to be 8.3 and 4.08 meq l^{-1}, respectively after one month of immersion. The mean concentrations of Na and K were 96 and 63.47 ppm, respectively during the period of study. The pH of the Yediyur lake water dropped from 7.24 to 6.7 after seven days of immersion activities. The BOD and COD levels increased from 11.3 and 97.5 to 19.3 and 134.25 mgL^{-1} in Yediyur lake in the post immersion period reflecting, anoxic aquatic environment. The concentrations of different inorganic ions including heavy metals (Cr, Cd, Ni and Pb) in the post immersion period were also found to increase. Since, water of these lakes can potentially be used in the lean season for irrigation in the adjoining agricultural lands as well as for other purposes; their proper management is of utmost necessity.

Keywords: idol immersion, paints, biological oxygen demand (BOD), Chemical oxygen demand (COD)

Introduction
Urban Lakes bear special significance these days as they act as a source of water in the cities during the lean season. Besides, they support aquatic ecosystem through biodiversity sustenance. Currently, urban lakes are in the merge of extinction due to encroachments, siltation and eutrophication from domestic and industrial effluents. The lakes in and around Bengaluru are also facing similar threats as evident from the satellite images and information available with Survey of India (Jumbe *et al*., 2008 and KSPCB, 2001) [8, 9]. These lakes are subjected to varying degrees of contamination and degradation. The deterioration of water quality in these lakes is primarily because of the discharge of contaminated sewage, organic, inorganic and hazaradous pollutants of both industrial and domestic origin. An important source of heavy metal contamination in the lake water is the immersion of painted idols as a part of religious activities (Clark *et al*., 2006; Kumar and Pastore, 2007; Kumar, 2007) [2, 11, 12]. The three principal components in synthetic paints are pigments, vehicles and solvents. Pigments are insoluble solids contributing color, containing heavy metals as one of their constituents. Lead is present in these pigments as oxides, hydroxides, carbonates and chromates. Vehicles help pigment adhere to a surface. They comprise of synthetic and phenolic resins. Solvents are added to adjust the consistency of the paint. Most widely used solvents are naphtha, mineral spirits and turpentine. Usually, solvent-based paints contain binders, pigment and organic solvents in the ratio of 1:1:2 (Johnson *et al.*, 2009) [7]. These paints are used for coating idols which are later immersed in the lakes as a part of rituals. Moreover, incorporating organic matter in the form of leaves, flowers *etc*., as a part of these activities, reduce dissolved oxygen which in turn adversely affect the aquatic environment (Desai and Tank, 2010) [4]. *Sindur*, a red coloured toxic powder containing lead and chromium, is also added to these lakes (Bubicz, 1982) [1]. These heavy metals, in due course of time, get adsorbed on the negatively charged silt and clay surfaces or simply get dissolved in lake water. The use of these heavy metal laden water and sediments for irrigation or as amendment can contaminate the food chain and affect plant and animal metabolism.

The transfer factors of these heavy metals in the plant system are dependent on soil properties (pH, Eh, moisture, microbial diversity, organic matter content *etc*.) and also the crop physiology. The translocation of heavy metals in edible plant parts follows the order: leafy vegetables > root crops > fruits. The use of heavy metal contaminated lake water for irrigation purpose has not only contaminated the vegetables and cereals but also animal milk (Lokeshwari and Chandrappa**,** 2006) [13]. Regular consumption of heavy metal contaminated plant parts and water cause biomagnifications in human and animal systems that may adversely affect the normal physiological functions. In this purview, a study was conducted with the objective of determining the effect of idol immersion activities on the lake water quality.

Materials and Methods

Yelhanka lake (13°06' N 77°34' E) is located at Yelahanka, 14 km north of Bengaluru. The total area of the lake is 10 ha. Yediyur lake (12°56'N 77°34'E) is one of the oldest lakes of Bengaluru, dating back to the Hoysala period. This lake was used to irrigate fields in the area even until 50 years ago.

Sampling of lake water

Water samples were collected randomly from five points of two different lakes of Bengaluru *viz*. Yelhanka and Yediyur, 30 days before immersion (T_1) and there after periodically at 1 (T_2), 7 (T_3), 14 (T_4), 30 (T_5) and 45 (T_6) days after immersion. The water samples were subjected to analysis for physicochemical parameters *viz*. pH, EC, alkaline and alkali earth elements *viz*. Ca, Mg, K, Na and metals *viz*. Fe, Pb, Cd, Cr and Ni.

Sample preparation

Water samples (500 mL) were filtered using Whatman No 41 filter-paper (0.45 µm pore size) for the estimation of the physicochemical properties and estimation of the dissolved metal content. The filtrates were preserved with 2 ml HNO_3 to prevent the precipitation of metals. The samples were then placed on a water bath and subjected to nitric acid digestion prior to the estimation of metals using Atomic Absorption Spectrophotometer (Perkin Elmer Analyst, 700). The physicochemical and biochemical parameters of the lake water were analysed using standard procedures (Manivasakam, 1987) [14].

Results and Discussion

Changes in physicochemical properties of lake water due to idol immersion

The EC of the Yelhanka lake water increased from 1.61 to 1.81 dS m^{-1} after seven days of immersion (Fig. 1). This might be due to the incorporation of several dissociable salts through the organic and inorganic materials. Similar results were observed in the Madiwala and Lalbagh lakes of Bengaluru (Gorain *et al.*, 2018) [5]. The mean electrical conductivity observed in the course of the study was 1.72 dSm^{-1} with a standard deviation of 0.06. The EC of the Yediyur lake water increased from 0.59 to 1.38 dS m^{-1}at seventh day after immersion. The mean EC observed in the course of the study was 1.14dSm^{-1}. The difference in the mean EC of the lake waters is a function of the degree of addition of salts through sewage, sludge, domestic effluents in addition to the run off from the adjoining agricultural fields during monsoon along with the extent of idol immersion (Ujjania *et al*., 2011; Mehta, 2013) [16, 15]. The pH of the Yelhanka lake water was found to decrease from 7.79 to 7.48 at 14th day after immersion. Similarly, the pH of the Yediyur lake water decreased from 7.24 to 6.7 (Fig. 2), two weeks after immersions. The reduction in pH may be attributed to the decomposition of organic materials added during the idol immersion as well as from the domestic sewage. The mechanism of pH reduction can be described by the following equations:

R-COOH → R-COO- + H+ (Eq. 1)
R-OH → R-O- + H+ (Eq. 2)

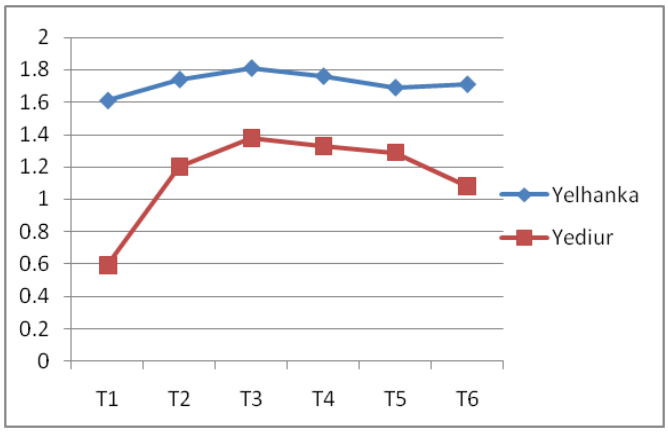

Fig 1: Changes in EC (dSm^{-1}) due to idol immersion

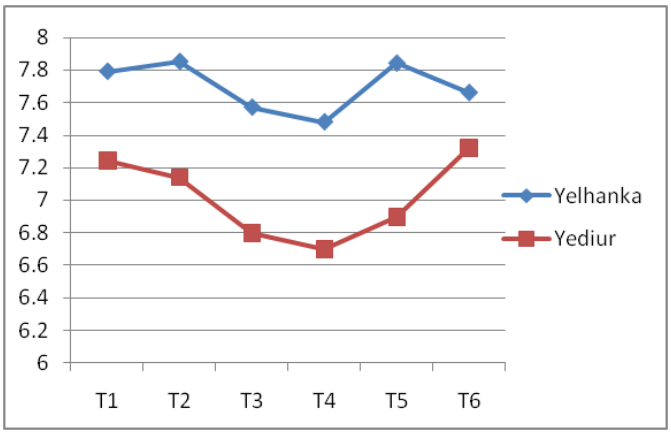

Fig 2: Changes in pH due to idol immersion

Contamination of lake waters with heavy metals and other inorganic ions

Yelhanka lake water

In Yelhanka lake, the concentration of Ca recorded was higher at 30 days after immersion (8.3 meq L^{-1}). The average concentrations of Mg, K and Na were also found to increase in the post immersion period (Table 1). The mean concentration of Fe in Yelhanka lake was 1.48 ppm (Fig. 3).The mean values of micronutrients like Cr and Cd were recorded as 0.03 and 0.001 ppm, respectively. The Pb content recorded 0.0007 ppm before immersion which increased to 0.0062 ppm, 30 days after immersion. However, the mean Pb concentration of the lake water during the entire course of the study was 0.012 ppm with a standard deviation of 0.003 ppm. The concentration of Ni, Cr, Cd, and Pb Yelhanka lake water varied from 0.012-0.0238, 0.015-0.068, 0.0009-0.0025 and 0.007-0.015, respectively (Fig. 4, 5, 6 and 7). The different heavy metals gradually increased with the immersion period might be due to their varying solubility rates as well as seasonal variations. Similar results in marine and freshwater systems were recorded by Kaur (2012) [10].

Table 1: Alkali and alkaline earth metals concentrations in Yelhanka lake water before and at different intervals after immersion of idols

Period of sampling	Ca	Mg	K	Na
	(meq L^{-1})		(ppm)	
T_1	4.8	2.9	59.8	93.4
T_2	5.5	2.6	61.5	95.6
T_3	6.7	3.7	62.7	99.2
T_4	4.4	2.6	60.7	97.66
T_5	8.3	4.08	68.3	94.9
T_6	6.5	2.89	67.86	95.2
mean	6.03	3.12	63.47	95.99
S.D.	1.43	0.61	3.69	2.08

T1: sampling before 30 days, T_2, T_3, T_4, T_5 and T_6: sampling 1, 7, 14, 30 and 45 days after idol immersion activities, respectively

Table 2: Alkali and alkaline earth metals concentrations in Yediyur lake water before and at different intervals after immersion of idols

Period of sampling	Ca	Mg	K	Na
	(meq l^{-1})		(ppm)	
T_1	8.70	1.5	0.7	71.1
T_2	9.55	2.7	1.6	77.6
T_3	11.93	6.36	4.4	81.5
T_4	13.57	5.35	3.9	78
T_5	15.50	8.31	4.2	72
T_6	14.60	7.68	3.5	75.3
mean	12.30	5.31	3.05	75.91
S.D.	2.74	2.72	1.52	3.93

T1: sampling before 30 days, T_2, T_3, T_4, T_5 and T_6: sampling 1, 7, 14, 30 and 45 days after idol immersion activities, respectively

Yediyur lake water

The concentration of Ca recorded was higher at 30th day after immersion (15.50 $meql^{-1}$). The average concentration of Mg, K and Na were 5.31 $meql^{-1}$, 3.05 ppm and 75.91 ppm (Table 2). Similar results were observed in river and fresh water bodies (Kaur, 2012 and Das, 2012) [10, 3]. The mean values of micronutrients like Cr and Cd were recorded as 0.001 and 0.002 ppm, respectively. The Pb content recorded 0.0007 ppm before immersion which increased to 0.0062 ppm, 30 days after immersion. However, the mean Pb concentration of the lake water during the entire course of the study was 0.00283 ppm with a standard deviation of 0.00252 ppm. The different heavy metals showed differential rates of increase in concentrations with the immersion period might be due to their different solubility rates as well as seasonal variations. The continuous build up of these alkaline earth and heavy metals, in the near future, may increase the hardness of water thereby deteriorating the water quality.

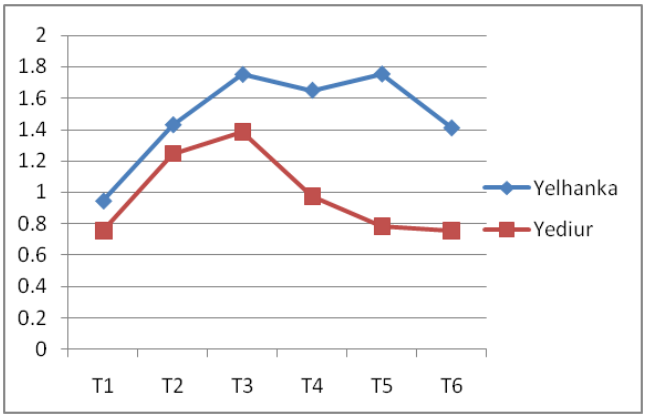

Fig 3: Changes in iron concentration (ppm) due to idol immersion

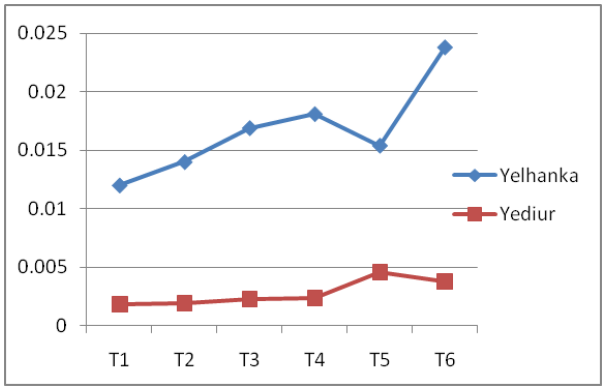

Fig 4: Changes in nickel concentration (ppm) due to idol immersion

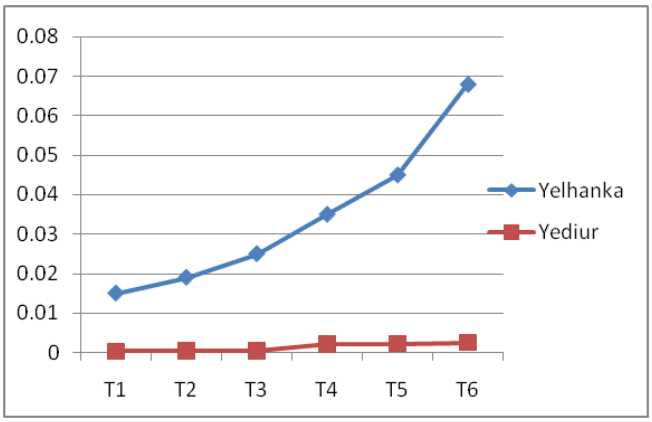

Fig 5: Changes in chromium concentration (ppm) due to idol immersion

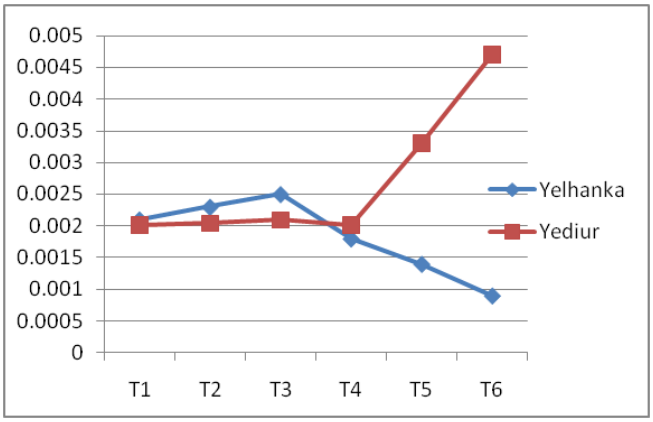

Fig 6: Changes in cadmium concentration (ppm) due to idol immersion

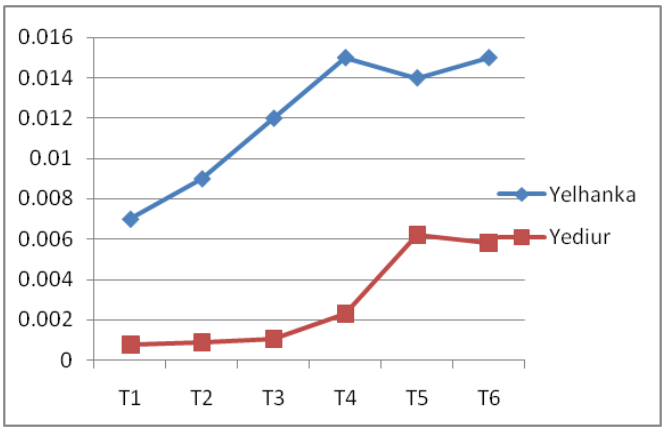

Fig 7: Changes in lead concentration (ppm) due to idol immersion

Fluctuation in biochemical properties of lake waters due to idol immersion activities

The Biochemical Oxygen Demand (BOD) of Yelhanka lake water, in the pre-immersion period was 11.5 mgL^{-1} which after 14 days of immersion was recorded to be 14.6 mgL^{-1} (Fig. 8). However, with time the BOD again decreased to13.8 mgL^{-1}. The BOD and COD of Yediyur lake water showed a steep increase from 11.3 and 97.5 mgL^{-1} in the pre-immersion period to 19.3 and 134.25 mgL^{-1} in the post immersion period (Fig. 8 and 9). The fluctuation in BOD of the lake water might be due to the dilution of biodegradable organic matter in the large volume of lake water. Similar trend was also observed in Hebbal and Bellandur lakes of Bengaluru (Gorain *et al*., 2018) [6]. The immersion of painted idols was accompanied with the addition of leaves, flowers and other organic materials used in the rituals in the lake waters. These materials upon decomposition increase the BOD and COD levels creating hypoxic conditions in the aquatic system.

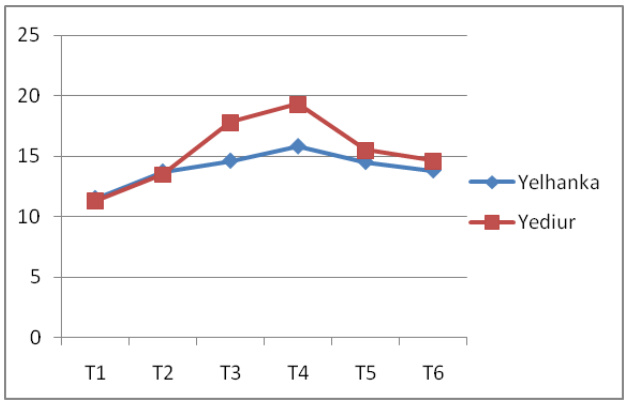

Fig 8: Changes in BOD concentration (ppm) due to idol immersion

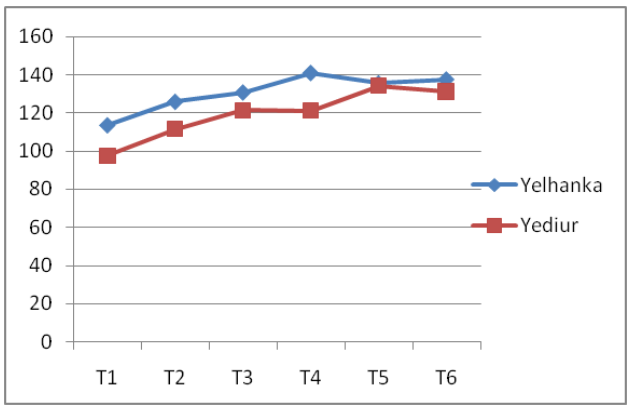

Fig 9: Changes in COD concentration (ppm) due to idol immersion

Conclusions

Yelhanka and Yediyur lakes of Bengaluru have the potential to meet the water demand of the adjoining areas during water scarcity. Incorporation of industrial and domestic effluents as well as religious activities like idol immersion is creating an uncongenial aquatic environment in these lakes. This is deteriorating water quality as well as making it unfit for human consumption as well as for agricultural purpose. The increased BOD and COD levels in the lake water during the course of study reflect significant addition of biodegradable organic matter during the idol immersion. The concentrations of toxic heavy metals e.g. Ni, Cr, Cd and Pb in the lake water increased in the post immersion period. Since, contamination of heavy metals even at very low concentration is detrimental to human and animal system, it is the time to generate public awareness regarding this issue. Some of the novel ideas that can curtail the problem to a large extent are the use of non-painted clay idols, use of dyes with organic origin instead of synthetic paints and utilizing organic wastes like flowers and leaves for compost preparation. This may restore the lake water quality without hurting the sentiments of the religious communes.

Acknowledgement

The authors are thankful to the University of Agricultural Sciences, Bengaluru and Indian council of Agricultural Research, New Delhi for providing the research infrastructure and financial support respectively.

References

1. Bubicz M. Heavy metal in the aquatic environment of some water bodies of the Lublin basin. Aquatic Hydrobiology. 1982; 24:125-138.
2. Clark CS, Rampal KG, Thuppil V, Chen CK, Clark R, Roda S. The lead content of currently available new residential paint in several Asian countries. Environmental Research. 2006; 102:9-12.
3. Das KK, Panigrahi T, Panda RB. Idol immersion activities cause heavy metal contamination in river Budhabalanga, Balasore, Odisha, India. International Journal of Modern Environmental Research. 2012; 2(6):4540-4542.
4. Desai J, Tank SK. Deterioration of water quality due to immersion of Ganesh idols in the river Tapti at Surat (India). Journal of Environmental Research and Development. 2010; 4(4):999-1007.
5. Gorain B, Parama VRR, Paul S. Heavy Metals Contamination in Madiwala and Lalbagh Lakes of Bengaluru, Karnataka: Effect of Idol Immersion Activities. Int. J Curr. Microbiol. App. Sci. 2018; 7(10):2254-2263. Doi: https://doi.org/10.20546/ijcmas.2018.710.260
6. Gorain B, Parama VRR, Paul S. Impact of Idol Immersion Activities on the Water Quality of Hebbal and Bellandur Lakes of Bengaluru in Karnataka, Journal of Soil Salinity and Water Quality. 2018; 10(1):112-117.
7. Johnson S, Saikia N, Sahu R. Centre for Sustainable Environment, Project Report, New Delhi, 2009.
8. Jumbe AS, Nandini N, Tandon S. Bangalore Lakes – Issues and perspectives on pollution, restoration and management. Proceedings of Taal 2007, The 12th World Lake Conference, 2008, 1699-1706.
9. Karnataka State Pollution Control Board – Research and Development Wing Publication, Monitoring and Analysis of Tanks and Lakes of Bangalore; KSPCB Publication, 2001.
10. Kaur R. Effect of idol immersion on marine and fresh water-bodies. Advances in Applied Science Research. 2012; 3(4):1905-1909.
11. Kumar A, Pastore P. Lead and cadmium in soft plastic toys. Current Science. 2007; 93(6):818-822.
12. Kumar A. Brush with Toxics- An investigation on Lead in Household Paints in India. Toxics Link Publication, New Delhi, 2007, 1-36.
13. Lokeshwari H, Chandrappa GT. Impact of heavy metal contamination of Bellandur lake on soil and cultivated vegetation. Current Science. 2006; 91(5):622-627.
14. Manivasakam N. Physico-Chemical Examination of Water, Sewage and Industrial Effluent. Pragathiprakashan Publication, Meerut, India, 1987, 1-268.

15. Mehta P. Alteration in water quality parameters and consequential impacts due to festival waste in Jodhpur. International Journal of Science and Technology. 2013; 17(1):1166-1176.
16. Ujjania NC, Multani AA. Impact of Ganesh idol immersion activities on the water quality of Tapi River, Surat (Gujarat) India. Research Journal of Biology. 2011; 1(1):11-15.