Effect of Idol Immersion on Water quality of Muthannankulam, Coimbatore, Tamil Nadu.

BY

PRIYANKA.S

[Reg.No.16PZO007]

THE THESIS SUBMITTED TO THE AVINASHILINGAM INSTITUTE FOR HOMESCIENCE AND HIGHER EDUCATION FOR WOMEN

COIMBATORE-641043

In partial fulfillment of the requirement for the degree of

MASTER OF SCIENCE IN ZOOLOGY

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SIGNATURE OF THE HEAD OF THE DEPARTMENT

SIGNATURE OF THE SUPERVISOR

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1. INTRODUCTION

Water is an important component for survival of life. The liquid descends from the clouds as rain, forms streams, lakes and seas and is a major constituent of all living matter and that when pure is an odorless, tasteless very slightly compressible liquid oxide of hydrogen H_2O which appears bluish in thick layers, freezes at 0℃ and boils at 100° C, has a maximum density at 4° C and a high specific heat, is feebly ionized to hydrogen and hydroxyl ions, and is a poor conductor of electricity and a good solvent. Water is an incredibly important aspect of our daily lives. All forms of life upon the earth depend upon water for existence (Rockstrom, 2006).

Water is used for various important purposes and it plays a major role in agriculture, industries and power station etc. Water is not only important for human beings but also plays an important role to balance the entire ecosystem (Wanganeo *et al*., 2012). Farming accounts for around 70% of water used in the world today and also contributes to water pollution from excess nutrients, pesticides and discharging wastes from various industries. But the competition for water is increasing and the costs of water pollution can be high. The world's ever increasing population based lifestyle has inevitably led to an increased anthropogenic impact on the biosphere. (Ubwa *et al.*,2013). Increased pressure from urbanisation, tindustrialisation and climate change is causing millions of people worldwide to suffer for storage of fresh and clean drinking water (Srivastava *et al*., 2006).

Water Pollution is the contamination of water bodies. It occurs as a result of introduction of pollutants in water. Water Pollution is mainly caused as a result of improper discharge of household and industrial chemicals waste into the water bodies (Akinbile, 2012). These dangerous chemicals (in the form of solid, liquid or gases) mixes with water and make it unsafe for living bodies. Water properties includes important factor such as pH, temperature, TSS, TDS, TS, COD, BOD, DO, salinity, calcium, phosphous, nitrogen nitrate, sulphate , phoshate, chlorides and sodium. Thus, the water and concentrations of plant nutrients required for the growth of phytoplankton, which is the base for food chain of the fish. The water quality is changed by pollution and contamination due to environmental condition, agriculture pollution and industrial pollution and idol immersion (Bhattacharya *et al.*, 2012).

Ganesh Chaturthi was celebrated all over India on September month. The festival was celebrated for a period of 10 days, on the last day Ganesh idols will be immersed into rivers and lakes (Brady,1996). With the passion of celebrating festival, we generally forget the hazardous impact of the immersion of idol on environment. After the immersion the ingredients of the state does not completely dissolve in water, which then leads to environmental pollution (Mishra *et al*., 2003).The idols of Ganesh is generally made up clay, plaster of paris (calcium sulphate hemi –hydrate), thermocol, plastic and cement. Toxic paints are also used in decorating the idol and colors used in decoration of idols contains harmful chemicals containing mercury and lead which leaks into water as idol dissolves. It increases acid content, total dissolved solids (TDS) and heavy metals in water. It kills aquatic plants and marine life, damaging ecosystem under water (Shukla *et al*., 2004). Due to the heavy metals and chemicals used for making the idols that causes the diseases like anaemia, arising blood pressure, kidney damage, disruption of nervous systems, brain damage, convulsions, chances of development of skin cancer, lung cancer, liver cancer and lymphatic cancer, skin irritation, lung irritation etc (Singh *et al*., 2011). The possible ways of dealing with this grave problem is by creating awareness among the masses. The lack of awareness among our people is the main reason behind in environmental pollution. Environmental awareness campaigns and meetings should be organized to make public aware of environmental damage caused due to immersion of idols into the river and pond system (Panda *et al*., 2012).

FIG.1: IMAGES SHOWING THE IDOL IMMERSION IN MUTHANNANKULAM AFTER GANESH CHADHURTHI

Recent years, we have seen increased awareness about water pollution caused by Ganesh Chaturthi immersion of Ganesh Idols in lakes, rivers and sea. After the idol immersion the pond was polluted (Mathieu, 2003). The present study concentrates the impact of idol immersion on water quality in Muthannankulam, Coimbatore, Tamil Nadu. This year around 108 Ganesh idols were immersed in Muthannankulam. It is located in the main city of Coimbatore, which was contaminated by idol immersion. Materials used in making of idols are high in poisonous chemicals and heavy metals. The impact of these colours can be heavy which leads to contamination. (Onianwa, 1999)

This study concentrates the physiochemical analyses such pH, temperature, BOD, COD, DO, TSS, TDS, TS, alkalinity, chromium, phosphate, nitrogen nitrate, chloride, sulphate, calcium, lead and sodium level were estimated in Muthannankulam water. The water health is not only depends upon the physiochemical parameters and also depends upon with microbial analyses. The enumeration, isolation of bacteria and colony count of bacteria were also analyzed. The determination of microbial analyses is used to observe the number of microbes present in the water, identification of bacteria, which are beneficial or harmful to the water.

Hence the present study aims to evaluate the physicochemical and microbial analyses of Muthannankulam before, after two weeks and after two months of idol immersion with the following objectives:

1. To characterize the physical properties (colour, odour, electrical conductivity, temperature, total suspended solids, total dissolved solids and total solids) of Muthannankulam before, after two weeks and after two months of idol immersion.

2. To characterize the chemical properties (pH, alkalinity, total hardness, dissolved oxygen, biological oxygen demand, chemical oxygen demand, chloride, sulphates, phosphates, nitrate- nitrogen, lead, nickel and chromium) of Muthannankulam before, after two weeks and after two months of idol immersion.

3. To enumerate the microbial colony (bacteria and fungi) of Muthannankulam before, after two weeks and after two months of idol immersion.

2. REVIEW OF LITERATURE

The available of literature pertaining to the present study entitled "Effect of Idol Immersion on water quality of Muthannankulam, Coimbatore, Tamil Nadu" was presented under the following headings.

2.1 IDOL IMMERSSION ON WATER QUALITY

Water Pollution, a major concern in India has been thriving since the past few decades. The introduction of contaminating and hazardous pollutants into the natural water leads to adverse changes leading to unavailability of fresh water for drinking and daily use. During festive season, immersion of idols has become a serious paints which are used to colour these idols contains various heavy metals such as mercury, cadmium, arsenic, zinc, chromium and lead. Particularly, the colours includes red, blue, orange and green colours contain mercury, zinc oxide, chromium and lead, which are potent carcinogens. Along with the idols, puja articles such as flowers, food offerings, metal polish, plastic sheets, cosmetic items and polythene bags are also submerged into the water. This leads to degradation that decreases the dissolved oxygen concentration in the river causing the death of the organisms living in the water body. These idols are decorated with plastic and thermocols. Out of the all materials used in making the idol, thermocol and plastic is non bio-degradable, hence are toxic. Lead and chromium are very toxic even in very small quantity for human being through the process known as bioaccumulation and bio magnifications. Heavy metal pollution caused by idol immersion can damage the ecosystem as it kills fishes, damages plants, blocks the natural flow of the water and causing stagnation. It damages health of human beings also by polluting drinking water sources, causing breathing problems, blood and skin diseases.

2.2 Physicochemical parameters

Fafioye *et al.*, 2005 studied the physico-chemical parameters such as dissolved oxygen ranged from 1.4 to 4.8 mg/L; pH, 6.7 to 7.2; temperature, 26.5 to 31.5°C; alkalinity, 24.2 to 25.4 ppm; conductivity, 23.0 to 28.3 Ohms/cm; turbidity 0.11 to 0.15 m; and free carbon dioxide from 3.5 to 4.5 mg/L. Dissolved oxygen, pH and water temperature serve as variables since the fluctuation of one affects the values of others. The result revealed that Omi water is safe for drinking when it was purified.

Vyas and Bajpai, 2008 conducted the study on water quality parameter such as turbidity, total hardness, dissolved oxygen (DO), biochemical demand (BOD) and heavy metals. Parameters like turbidity, biological oxygen demand (BOD) and heavy metal become higher in post idol immersion but dissolved oxygen (DO) become higher in during idol immersion. The immersion of idols has grown in number and size over the years and urban water bodies are facing on increasing nutrient load. The idol immersion activity leads to drastic changes for adding pollution load and detioration of ecosystem of the lake.

Chaudhary *et al.*, 2009 conducted the study on physico-chemical characteristics of some selected ponds at Dhar town. The sampling points were selected on the basis of idol immersion sites. Sampling was done before and after the idol immersion. Results showed variation in some parameters which produced pollution in such water bodies and harmful effects on animals and fishes.

Bajpai *et al.*, 2009 reported that water quality of lake are normally get contamination everywhere by accumulation of sediments, human waste, sits organic matter, industrial waste but in India different type of religious activities (Idol immersion) are take place every year to which other country are not concern.The immersion of idol of Lord Ganesh and Navratris festival is a major source of contamination and sedimentation to the lake water.The idol are been made up of Clay, Plaster of paris, cloth, paper, wood, thermocol, jute, adhesive material and synthetic paints etc. Out of the all-martial used in making the idol, thermocol is Non-Biodegradable while paints contain heavy metals such as chromium, lead, cadmium and mercury.

Bhawan *et al.*, 2010 reported that during festive occasions immersion of idols in water bodies like rivers, lakes, ponds, estuaries, open coastal beaches and wells etc. were being contaminated and has been a matter of concern. In addition to silting, toxic chemicals used in making idols tend to reach out and pose serious problems of water pollution. The results concluded that deterioration in water quality due to idol immersion reveal deterioration of water quality in respect of conductivity, bio-chemical oxygen demand and heavy metal concentration.

Jena *et al.*, 2012 conducted an experiment to assess the Water Quality Index (W.Q.I) of pond water and the impact of human activities on it. Physicochemical parameters were monitored for the calculation of W.Q.I for the rainy, winter and summer seasons. The parameters namely pH, Total hardness, TDS, Calcium, Chloride, Sulphate, Sodium, Potassium, EC and DO values were within the permissible limits on the other hand total alkalinities and magnesium values were exceeding the permissible limits as prescribed by Indian Standards. However, the W.Q.I values were reported to be 83.43, 76.598 and 91.52 for different season indicating that the pond water quality is very poor and not totally safe for human consumption.

People on globe are under tremendous threat due to undesired changes in the chemical of air, water and soil. Due to increased human population, industrialization, use of fertilizers and man-made activity water is highly polluted with different harmful contaminants. Natural water contaminates due to weathering of rocks and leaching of soils, mining processing etc. It is necessary that the quality of drinking water should be checked at regular time interval, because due to use of contaminated drinking water, human population suffers from varied of water borne diseases. The availability of good quality water is an indispensable feature for preventing diseases and improving quality of life. It is necessary to know details about chemical parameters such as, sulphate, chloride, alkalinity used for testing of water quality. Heavy metals such as Pb, Cr, Fe, Hg etc. are of special concern because they produce water or chronic poisoning in aquatic animals (Sawant *et al.*, 2012).

Bhattacharya *et al.,* 2014 were carried out a study to find out the effects of immersion of idols on water quality by collecting and analyzing the water samples from the immersion sites of the rivers. The samplings were done before the immersion, on the day of immersion and after the event and several parameters like salinity, alkalinity, TDS, total hardness, chlorides etc. are estimated. The results revealed that significant changes in the water quality parameters during and after immersions. Idol immersion, materials which are used in idol making that do not dissolve easily in water, thereby reducing the oxygen level and physicochemical characters are become changed in the water bodies.

The impact of Ganesh idol immersion on water quality of Tapi River was reported by Ujjain *et al.*, 2015. The changes in physico-chemical properties of Tapi River were observed except temperature, pH and DO with minor changes while CO2, BOD, COD, total alkalinity, total hardness, total calcium, and oil & grease were observed with major changes during immersion period. On the basis of these changes it was concluded that level of water pollution increases in Tapi River due to these religious activities and causes adverse effect on the aquatic ecosystem.

Mohini *et al.*, 2015 studied the physico-chemical properties of water to evaluate the nature and extent of pollution in water bodies due to idol immersion. An artificial pond nearly 20x10 metre size with polythene lining was constructed in September 2013 near Dumas Ovara by SMC for immersion of idols. Pre-immersion and post-immersion samples were collected from the artificial pond and analyzed for various water quality parameters such as pH, turbidity, total Solids (TS), total dissolve solids (TDS), total suspended solids (TSS), turbidity, conductivity, total hardness, calcium hardness, dissolved oxygen (DO), BOD, COD and oil & grease. The results indicated that the pollution load on artificial pond has increased significantly after idol immersion.

Rehman *et al.*, 2015 conducted the study to evaluate the physicochemical parameters including pH, conductivity, TDS, color, odor and elasticity. The obtained results were pH=7.21for water samples and pH=7.26 for soil samples, TDS=50mg/50ml for water samples and TDS= 80mg/50ml for soil samples, conductivity=1.08µS/cm for water samples and conductivity=3.92µS/cm for soil samples. It was concluded from results that physical and chemical parameters of water and soil were within the normal range given by WHO and also water of DandiIdarKhel Lake was suitable for fish breeding.

Water is a precious resource without which life on earth would not have sustained. Human beings can survive without eating food for several days, but without drinking water they cannot survive. Water is used not only for drinking, but is also used for washing, cooking, bathing and other purposes. Kumar et al., 2016 reported that around 1.1 billion people do not have access to an improved and pure form of water resources and over three million people of which mostly are the children die from water-related diseases every year. Developed countries consumes large amount of clean water than the developing countries that lacks the latest technologies are always left stranded when it comes to clean drinking water. Water quality refers to the characteristics of water such as dissolved minerals, free from soluble primary or secondary metabolites, colour and odour that determine the water being fit for human uses. It is perfectly clear from this that water quality has tremendous effects on not only in short term but in long term to the human.

The extent of idol immersion increases with increasing population which is alarming situation of Dashamighat. The chemical parameters and metals concentration of the water samples were evaluated. The analysis was carried out for alkalinity and metals such as magnesium, calcium, cadmium, chromium, lead, iron and arsenic. The result obtained reveals that Haora river water become acidic after idol immersion and all the chemical parameters were found within the permissible limit with a few exceptions. The concentrations of metals were found within the permissible limits except for chromium, iron and lead which is slightly higher than the permissible limit. The trend of increasing such parameters indicates that idol immersion activity affects the water quality to the extent with respect to self-purification of the water and flow of the stream of the river (Singh *et al.*, 2016).

India is the country of rich cultural heritage and festivals. Peoples here celebrate festivals with great enthusiasm. Among all the Indian festivals 'Ganesh utsav' and 'Durga puja' is celebrated by every community. These festivals end by idol immersion in water. These idols are made up of degradable and non-degradable components and paints containing heavy metals due to that immersion activity deteriorates water quality. The present study has been made to analyze the physicochemical parameters of the Chandrabhaga river after idol immersion for analyzing the various physicochemical parameters such as Temperature, pH, TDS, DO, Phosphate , Nitrate, BOD, COD, Oil &Grease, etc. The work highlights the condition of this river water after idol immersion with respect to the parameters mentioned above (Watkar*et al.*, 2017).

2.3 Biological parameters

Water resource of the earth is part of a finite close system, and in any time period when population are rising, the per capita amount of water available is inevitably decreasing. Water quality of lake are normally get contamination everywhere by accumulation of sediments, human waste, organic matter, industrial waste but in India different type of religious activities (Idol immersion) are take place every year to which other country are not concern. The idol are been made up of Clay, Plaster of paris, cloth, paper, wood, thermocol, jute, adhesive material and synthetic paints etc. Out of the all martial used in making the idol, thermocol is non-biodegradable while paints contain heavy metals such as chromium, lead, cadmium and mercury. The results of the study revealed that heavy metals which pose a serious threat to humans, animals and aquatic species. It is getting pollution due to household, industrial, agricultural waste, sewage discharge as well as religious activities. Heavy metals are one of the major pollutants which are harmful to human, animals and tend to bioaccumulate in food chain. Use of phytoremediation technique for removal of toxic metals is an ecofriendly and sustainable approach to control water pollution. Plant growth was higher in polluted water. Control indicating the high tolerance of the plants to the stress level (Verma *et al.*, 2007).

Kido *et al.*, 2009 conducted the study to evaluate the water quality and to compare those levels of environmental contaminants in developing and developed countries; water quality and contents of endocrine disrupters were measured in a total of different area of rivers. The results of the study indicated that microbial analyses which produce pollution in such water bodies and harmful effects on animal and fishes .In rivers, the plants which are present was destroyed due to heavily polluted. Pollution in the river water in Indonesia appeared to be caused by the lack of sewerage systems. In addition, the findings on endocrine disrupters indicated that the concentration of alkyl phenol in samples was large enough to affect living organisms.

Mitali *et al.*, 2012 observed the impact of Ganesh idol immersion on Tapi River. For this purpose water sample were collected from Nanpura immersion point at morning during pre immersion, immersion and post immersion periods of Ganesh idols. This show the result in decrease in the dissolved oxygen, BOD and free CO2, whereas increase in the total alkalinity, total hardness, total Calcium, COD, Oil and Grease, temperature and pH were observed during immersion period. On basis of these changes it is concluded that level of pollution increase in Tapi River due to this religious activity and adversely effect on water quality of this river. In view of the observed changes in the water quality, there is need to aware masses to use eco-friendly material for idol so that culture and environment can be preserved in a cohesive manner.

Immersion of idols in the river during the festival season has become a cause for concern because of increased use of cheap lead and chrome-based paints in most of them. Increased use of plaster of Paris is not only affecting the humans and animals dependent on them but is also deteriorating the ecological condition of the river. During the immersion ceremony, puja articles such as polythene bags, foam cutouts, flowers, food offerings, decorations, metal polish, plastic sheets, cosmetic items, all of which are highly polluting, and thrown into the water. The composed data was analyzed for the year 2011, to understand deterioration in the water quality of the river due to idol immersion practices. According to the results, the value of DO, BOD, total solids and COD were found to vary from 6.0-7.5 mg/L; 3.3-38 mg/L; 430-1268 mg/L; 28136 mg/L respectively. The low levels of DO and high BOD and Total solids levels at different sites indicate the poor water quality due to idol immersions. Microbial analysis focusing on bacteria was done quantitatively. Identification of isolated bacteria was done by performing several Biochemical tests. Some physiochemical parameters were also analyzed. CFU values show that it comes in the normal range. Analyzing biochemical test results of two isolated bacteria strain (D2 and D1), it was predicted that these two strains might belongs to *Enterobacter* sp. and *Streptococcus* sp (Kaur *et al*., 2013).

Water of Futala-Telangkhedi lake was examined before a week of idol immersion, at the time of idol immersion and one week after the immersion of idols. It is situated in the West Nagpur of Central India surrounded by wetlands, farmlands, forests and gardens etc. The variations in habitats and ecological conditions of lake are suitable for diverse range of flora and fauna. The idols are prepared from degradable and non-degradable components and paints containing heavy metals deteriorate the quality of water. It directly affects the flora and fauna of this lake. The floating materials released during idol immersion after decomposition result in eutrophication of the lakes. Lakes and other water bodies are the most fragile, fertile, diverse, productive and interactive which have more complex ecosystem in comparison to running waters as they lack self-cleaning ability and hence readily accumulate great quantities of pollutants. Increased human activities damage the aquatic ecosystems andultimately affect the quality of water (Kishoe *et al*., 2014).

The physicochemical parameters showed an increase when the sewage and industrial channel joined the river. Changes in the biotic communities; phytoplankton, zooplankton and macro zoobenthos have been explained numerically in terms of abundance and diversity index. Phytoplanktons, zooplanktons, as well as macro zoobenthos showed a decrease in population and diversity values with an increase in pollution, along with a correlation with physico-chemical aspects. Navicula, Cocconeis, Closterium, Micrasterias, Dactylococcus and Oscillatoria were the common phytoplankton. Taxa, Keratella and Brachionus were common zooplanktons and Tubifex was the common benthic organism with a wide range of tolerance to different physico-chemical conditions. The extent of pollution by certain heavy metals such as Cu, Zn, Ni, Co, Cd and Pb were observed (Anita *et al*., 2014).

The impact of Ganesh Idol immersion on water quality of Kakerpura Lake, Mhow was investigated. Water samples were collected in morning at different intervals i.e. pre-immersion (August) immersion (September, October) Post immersion period (November). The Ganesh Idolsare made up of degradable and non-degradable components and paints containing heavy metals due to that immersion activity deteriorates water quality. The physico-chemical parameters showed the significant variation due to immersion of idols. The main reason of the deterioration in water quality is various ritual activities in that "Idol immersion" plays an important role because these idols are made by plaster of paris and clothes, small iron rods, chemical colours, varnish and paints used as decorative components. This religious activity cannot stop but awareness among people and proper management practices like use of eco-friendly Ganesh idols natural colors etc can reduce the pollution problem of water bodies up to some extent (Billore and Dandawate, 2015).

Nag and Pande, 2015 observed the physical and chemical changes in Yamuna river due to idols immersion (before, during and after the immersion). There was significant change in physical and chemical parameters during the time of immersion.An investigation on the bacteriological analysis of water samples collected from three polluted sites of Yamuna River –Wazirabad, ITO and Okhla compared to tap water, used as control. The results were analysed and match up to the standards laid by the Bureau of Indian Standards

(BIS). For phytoremediation study, the three aquatic plants Eichhornia, Salvinia and Hydrilla were selected on the basis of their availability in River. Our results clearly indicated that ITO water sample was the most polluted as the total dissolved solids, turbidity and total hardness were the highest in those sample. Among heavy metals, arsenic content was ten times higher beyond BIS permissible limit in Okhla sample. Chromium (Cr) content was the highest in Wazirabad, followed by ITO. Plant growth was higher in polluted water than control indicating the high tolerance of the plants to the stress level. Investigation for remediation of heavy metals by phytoremediation is still under progress (Kathal *et al*., 2016).

Idol immersion activities during festive occasions deteriorate water quality in urban lakes and considered as an anthropogenic activity. Water quality assessment is an important exercise to evaluate the nature and extent of negative impact of idol immersion on water quality parameters. As lakes have more fragile ecosystem because they do not have or very little self purification capacity and it gets polluted very quickly. The incidence of fish kills in urban lakes due to immersion or due to cloudy weather conditions or eutrophication etc. have been on rise in the recent years (Belsare*et al*., 2017).

3. MATERIALS AND METHODS

The methodology for the present study on "Effect of Idol Immersion on water quality of Muthannankulam, Coimbatore, Tamil Nadu" is described as follows.

3.1 Collection of water sample

The water samples were collected from Muthannakulam of Coimbatore district, Tamil Nadu (Fig.1). Muthannakulam (length- 2.21Km) (11°0'11.52 latitude and 76°56'36.24 longitude) is situated in the west of Tadagam road and south of Thondamuthur road and receives water from Selvampathy Lake.

The samples were collected in precleaned 5L polythene bottles during the month of August 2017 one week before of Ganesh chathurthi (sample 1). The sample 2 was collected after two weeks the immersion of Idol during the month of October 2017 (Fig.2). The sample 3 was collected two months after the immersion of Idol during the month of December 2017 (Fig.3). Samples were preserved in a refrigerator at $4^{\circ}C$ till the completion of the investigation.

3.2 Physicochemical characterization of the water samples

The samples were subjected to various physicochemical analyses. The physicochemical properties analysed, their methods of analysis, the appendices in which the methods were described and the respective references are given in table 1.

TABLE 1
Physicochemical characteristics of water sample

S.No	Parameters	Methodsof analysis	References	AppendixNo.
1	Colour	Visual	-	-
2	Odour	Smell	-	-
3	Electrical conductivity (µmhos/cm)	Conductivity bridge	-	-
4	Temperature (^{O}F)	Thermometer	-	-
5	Total suspended solids (mg/l)	Filtration	APHA, 1998	1
6	Total dissolved solids (mg/l)	Evaporation	APHA, 1998	2
7	Total solids(mg/l)	Calculation		3
8	pH	pH meter	APHA, 1998	4
9	Alkalinity (mg/l)	Titrimetry	APHA, 1998	5
10	Total hardness(mg/l)	Titrimetry	APHA, 1998	6
11	Dissolved oxygen (mg/l)	Winkler's method	APHA, 1998	7
12	Biological oxygen demand (mg/l)	Titrimetry	APHA, 1998	8
13	Chemical oxygen demand(mg/l)	Titrimetry	APHA, 1998	9
14	Chloride (mg/l)	Titrimetry	Vogel, 1964	10
15	Sulphate (mg/l)	Titrimetry	APHA, 1998	11
16	Phosphate (mg/l)	Titrimetry	APHA, 1998	12
17	Nitrate nitrogen (mg/l)	Titrimetry	APHA, 1998	13
18	Lead (mg/l)	Colorimetry	APHA, 1998	14
19	Nickel (mg/l)	Colorimetry	APHA, 1998	16
20	Chromium (mg/l)	Colorimetry	APHA, 1998	17

3.3 Microbial analyses

The samples were subjected to various microbial analyses. The microbial test studied their methods of analysis, and the appendices in which the methods were described and the respective references are given in table 2.

Table 2

Characteristics of microbial analyses in water

S. No	Test analysis	Reference	Appendix
1.	Isolation and total count of bacteria	Abdulkadir, 2012	1
2.	Isolation and total count of fungi	Abdulkadir, 2012	2

FIG. 2: MAP SHOWING THE LOCATION OF MUTHANNANKULAM IN COIMBATORE DISTRICT OF TAMIL NADU

FIG. 3: COLLECTION POINT OF WATER SAMPLES IN MUTHANNAN KULAM OF COIMBATORE DISCRICT, TAMIL NADU

FIG.4: COLLECTED WATER SAMPLES FOR PHYSICOCHEMICAL CHARACTERISTICS AND MICROBIAL ANALYSES

4. RESULTS AND DISCUSSION

The results of the present study investigation of Effect of Idol Immersion on water quality of Muthannankulam, Coimbatore, are presented in this chapter.

4.1 Physicochemical characterization of the water samples

The physicochemical characteristics of the water samples were depicted in table 3 and 4. The water samples before, after and two month Idol immersion during Ganesh chathurthi festival at Muthannakulam of Coimbatore district was characterized for their pollution potential. Fig 1.

4.1.1 Characterization before idol immersion

The water sample from the area was found to be colourless and odourless. The temperature recorded at the time of collection was 30 °C

The EC of the sample was found to be 1020 µmho/cm. Total solids (TS) estimated amounted to 1900 mg/l; total dissolved solids (TDS) was found to be 1705 . The water sample contained 295mg/l of suspended solids. The pH noted was 7.1. The alkalinity observed were 124 mg/l. Total hardness estimated was 604 mg/l. The amount of calcium and magnesium were found to be 212 mg/l and 104 mg/l respectively.

Dissolved oxygen content were 3.5 mg/l. BOD and COD were 16.6 mg/l and 304 mg/l respectively. The amount of chlorides, sulphates was 999.5 mg/l, 0.74 mg/l respectively. Phosphates were nil. The fluoride content was below dedectable limit (BDL). The amount of nitrate nitrogen was 0.02 mg/l. Nickel concentration was found to be2.40 .The idol immersion sample was found to be dark violet in colour with objectionable odour. The electrical conductivity recorded was 360µmho/cm. The temperature of the sample at the time of collection was 40°C. The values of total suspended solids (TSS), total dissolved solids (TDS) and total solids (TS) were found to be 100, 105, 110 mg/l respectively.

The results of the physicochemical analysis showed that the water is characterized by the presence of colour with objectionable odour, high electrical conductivity, high TSS, TDS values, alkaline pH, high BOD and COD, low DO, high amounts of chlorides and sulphates, nitrate nitrogen lead and nikel also showed the presence of heavy metals, lead and chromium was observed and given in the Table 3.

4.1.2 Characterization after two weeks idol immersion

The water sample from the area was found to be colourless and odourless. The temperature recorded at the time of collection was 300c.The EC of the sample was found to be 1081 µmho/cm.

Total solids (TS) estimated amounted to 1900 mg/l; total dissolved solids (TDS) was found to be 1705 . The water sample contained 100 mg/l of suspended solids.The pH noted was 7.3. The alkalinity observed was 175 mg/l. Total hardness estimated was 173 mg/l. Dissolved oxygen content was 5.3 mg/l. BOD and COD were 15.8 mg/l and 295 mg/l respectively.The amount of chlorides, sulphates was 198.7 mg/l, 107 mg/l respectively.

Phosphates 0.042 The fluoride content was below dedectable limit (BDL). The amount of nitrate nitrogen was 0.028 mg/l. Nickel concentration was found to be 2.40mg/l The above results physicochemical analysis showed a significant difference between before and after physicochemical parameter. In comparison with BIS limits it was found that the parameters exceeding the prescribed permissible limit are TSS, TDS, pH, BOD, COD, chlorides, nitrates, lead and nikel after idol immersion were recorded all these parameter lower the permissible limit.

4.1.2 Characterization after two months of idol immersion

The water sample from the area was found to be colourless and odourless. The temperature recorded at the time of collection was 300c.The EC of the sample was found to be 1081 µmho/cm. Total solids (TS) estimated amounted to 1900 mg/l; total dissolved solids (TDS) was found to be 1705 .

The water sample contained 100 mg/l of suspended solids.The pH noted was 7.3. The alkalinity observed was 175 mg/l. Total hardness estimated was 173 mg/l. Dissolved oxygen content was 5.3 mg/l. BOD and COD were 15.8 mg/l and 295 mg/l respectively.The amount of chlorides, sulphates was 198.7 mg/l, 107 mg/l respectively.

Phosphates 0.042 The fluoride content was below dedectable limit (BDL). The amount of nitrate nitrogen was 0.028 mg/l. Nickel concentration was found to be 2.40mg/l From the analysis to be the idol immersion after 2 months of the sample has TDS, TSS,TS, pH, temperature,EC, BOD,COD,DO are increased from the leave of before idol immersion and decreased from the level of after idol immersion.

The above results showed a significant difference between treated with respect to the physicochemical parameters. In comparison with BIS limits it was found that the parameters exceeding the prescribed permissible limit are TSS, TDS, pH, BOD, COD, chlorides, nitrates, lead, nikel, after idol immersion were recorded all these parameter lower the permissible limit.

Table 3

Physical parameters of water sample before, after two weeks and after two months of idol immersion and BIS permissible limits

S. No.	Parameters	Sample 1	Sample 2	Sample3	BIS permissible limits
1	Colour	colorless	Colorless	Colorless	-
2	Odour		Bad odour	Objectionable odour	-
3	Electrical conductivity (EC) (µmho/cm)	1020	1005	1015	600
4	Temperature (ºC)	27.4	25.2	26.3	>40
5	Total suspended solids (mg/l)	100	182	115	100
6	Total dissolved solids (mg/l)	1507	1460	1490	2100
7	Total solids (mg/l)	1900	1775	1800	-

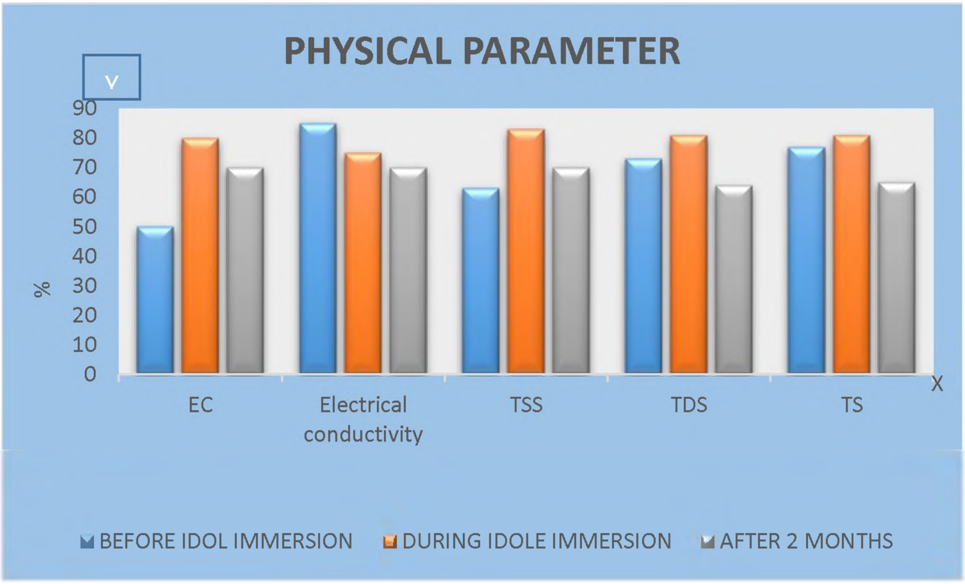


FIG: 5. Physical parameters of water sample before, after two weeks and after two months of idol immersion and BIS permissible limits

Table 4

Chemical parameters of water sample before, after two weeks and after two months of idol immersion and BIS permissible limits

S.No.	Parameters	Sample 1	Sample 2	Sample 3	BIS permissible Limits
1	pH	7.3	6.5	7.1	5.5 - 9.0
2	Alkalinity(mg/l)	175	182	115	200-600
3	Totalhardness(mg/l	173	163	172	600
4	Dissolved oxygen(mg/l)	5.3	5.0	4.5	-
5	Biological oxygen demand (mg/l)	15.8	13.3	14.5	30
6	Chemical oxygen demand(mg/l)	295	280	284	250
7	Chloride (mg/l)	198	192	180	1000
8	Sulphate (mg/l)	107	123	115	1000
9	Phosphate (mg/l)	0.042	0.048	0.038	5
10	Nitrate nitrogen(mg/l)	0.028	0.032	0.025	50
11	Lead (mg/l)	0.234	0.242	0.025	0.1
12	Nickel (mg/l)	2.40	2.35	2.370	3
13	Chromium (mg/l)	0.008	0.012	0.005	2

All the values except pH are in mg/l

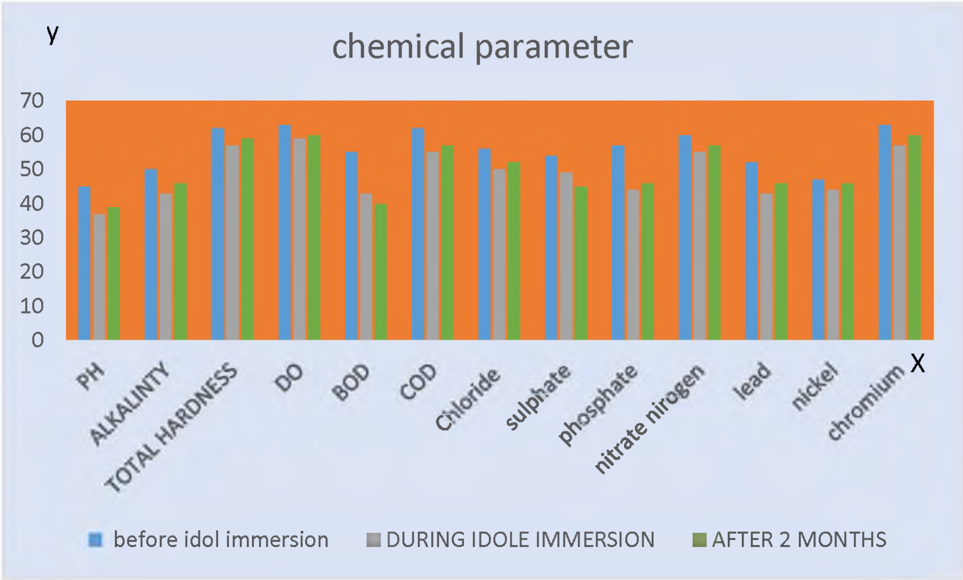


FIG: 6. Chemical parameters of water sample before, after two weeks and after two months of idol immersion and BIS permissible limits

4.2 Microbial Analyses

The microbial colony (bacteria and fungi) was observed in Muthannankulam water sample before, after two weeks and after two months of idol immersion. The results showed positive result for bacterial colony.

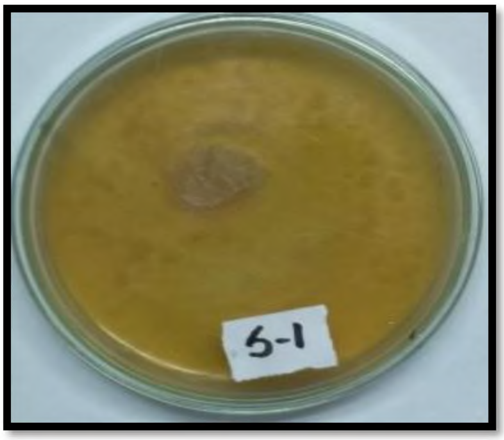
4.2.1 Enumeration of bacterial population

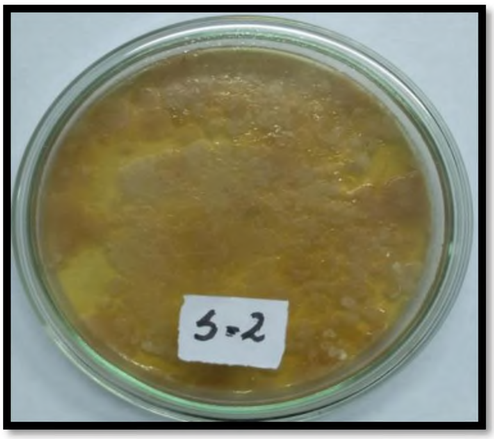
The number of colony forming units per gram was analyzed before after two weeks and after two months of idol immersion in the water sample were given the below table 5.

Table 5

No .of sample	Dilution	No. of colonies	CFU per g
Sample 1	10^{-6}	3	3×10^{-8}
Sample 2	10^{-6}	64	64×10^{-8}
Sample 3	10^{-6}	23	23×10^{-8}

The number of colony forming bacterial units per ml of sample was calculated to be sample I, 3x 10^{-8} CFU/ml, in sample II 64x 10^{-8} CFU/ml and in sample III 23 x 10^{-8} CFU/ml.



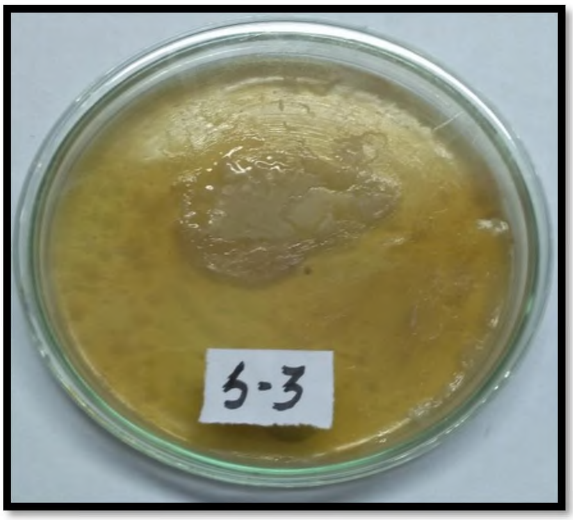


SAMPLE – 1(S-1)

Before idol immersion

SAMPLE – 2 (S-2)

After two weeks of idol immersion



SAMPLE – 3

After two months of idol immersion

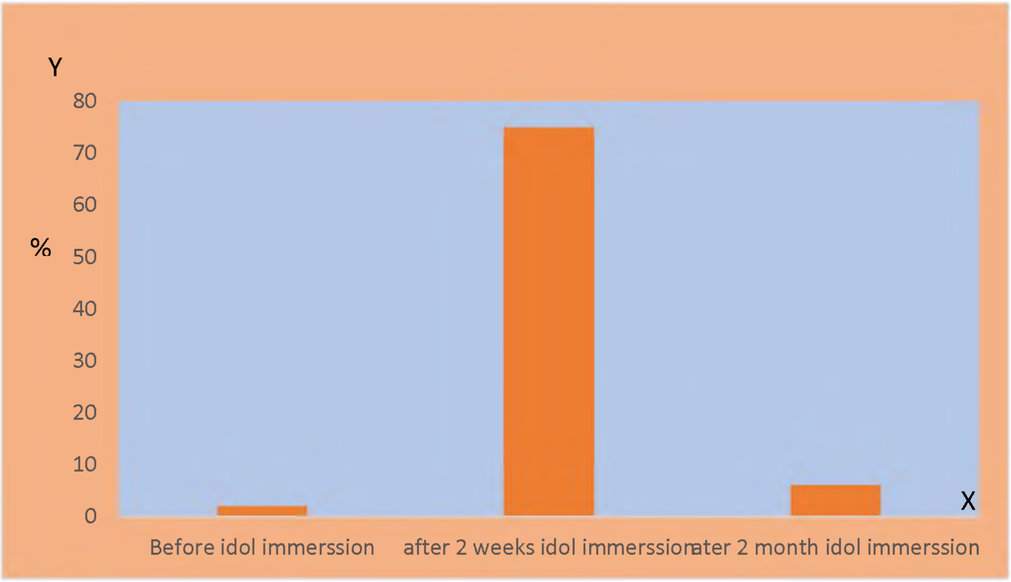


FIG: 7. Enumeration of bacterial population

4.2.2 Enumeration of fungal population

The number of fungal colony forming units per gram was analyzed before after two weeks and after two months of idol immersion in the water sample were given the below table 6.

Table 6

No .of sample	**Dilution**	**No. of colonies**	**CFU per g**
Sample 1	10^{-8}	2	2 x 10^{-8}
Sample 2	10^{-8}	75	75 x 10^{-8}
Sample 3	10^{-8}	6	6 x 10^{-8}

The number of colony forming bacterial units per ml of sample was calculated to be sample I, 2x 10^{-8} CFU/ml, in sample II 75x 10^{-8} CFU/ml and in sample III 6 x 10^{-8} CFU/ml.

SAMPLE – 1(S-1)

Before idol immersion

SAMPLE – 2 (S-2)

After two weeks of idol immersion

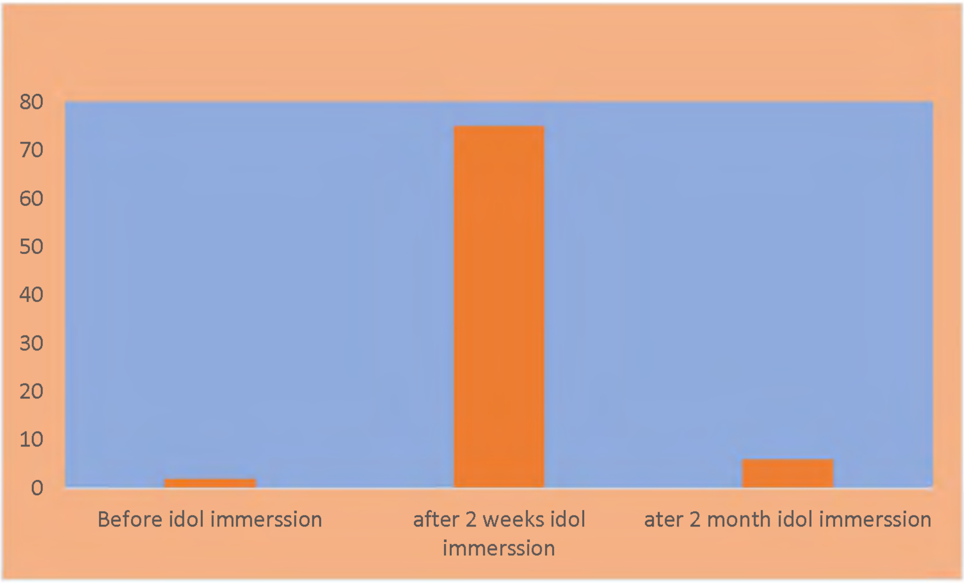


FIG: 8. Enumeration of fungal population

DISCUSSION

The results of the present investigation on "Effect of idol immersion of water quality on Muthannankulam, Coimbatore, Tamil nadu" are discussed and presented in this chapter.

4.1 Physicochemical characteristics of water sample

Colour

Colour is a common constituent of natural water. The determination of colour is rapid and is useful in detecting a change in the character of the water. Colour is removed to make water suitable for general and industrial applications.

Odour

In its pure form water cannot produce odour or taste sensations. Most organic and inorganic chemicals contribute taste or odour. These chemicals may originate from municipal and industrial waste discharges, from natural sources such as decomposition of vegetable matter or from associated microbial activity. The usual requirement of water sample is that they should not contain any objectionable odour

4. 4 Physicochemical characterization of the water samples

Electrical Conductivity (EC)

Electrical conductivity is a measure of water capacity to conduct electric current (Arias *et al.*, 2005). The electrical conductivity of a water solution increases with the increased concentration of ions. Electrical conductivity is a very quick, simple and inexpensive method to check health of water. It is a measure of ions present in solution (Onwuka and Uzoukwu 2008).

In the present study, the electrical conductivity of water sample before idol immersion (sample-1) was found to be 1020 µmhos/cm and after two months of idol immersion (sample-3) showed 1705µmhos/cm, both the values of sample 1 and 3 were within the BIS limits. According to Singh (1999) electrical conductivity limits from 400 to 600µmhos/cm is useful for the plant growth and microbes decomposition.

After two weeks of idol immersion, (sample-2) the electrical conductivity value is 1900 µmhos/cm. This result was in coherence with Shivanna and Nagendrappa, (2014), who reported that the EC values above the BIS limit 600 µmhos/cm, indicates high salinity status of the water and leads to the production of harmful microbes in the water as a results nutrient in the water decreased. From this observation the decreased EC values after two months of idol immersion was due to degradation and biosynthesis of the water.

Temperature

Saroj Mahajan *et al.,* (2014) reported that the water temperature depends on the ratio of the energy absorbed. The optimum temperature range between -20 to 40 °C in water. The temperature of the water is the most important property. Because it effect on the chemical, physical and biological processes related to growth of plants (Thripathaiah et al. 2012 and Shyamalaet al., 2008). In the present study the temperature before idol immersion is normal (27.4°C) and after two weeks of idol immersion it increased (25.2°C) and after two months of idol immersion temperature is normal (26.3°C) in the water. This investigation coincide with the finding's of Bordalo *et al*., (2006). He reported that the idol immersion increases the water temperature which comes to normal after 40 days due to the action of clay with environmental condition (climatic condition, time, season).From this observation the plants and aquatic animals gets affected due to the lowered temperature lowered after two weeks of idol immersion.

TS, TDS, TSS

The effect of organic pollution is an immediate rise in the concentration of various solids. The pollution has a direct relationship with the dissolved solids and suspended solids (Verma *et al.,* 1977 and Prasad and Saxena, 1980).

The TSS, TDS and TS of the sample 1, was 100, 1507 and 1900 mg/l and sample 2 showed 182, 1460 and 1775 mg/l and in sample 3 recorded 115, 1490 and 1800 mg/l was analysed among the three samples, sample 2 produces the organic pollution to the water due to the diluted of some chemicals and heavy metals. The similar observation was made by Saramanda geetha, (2017). She reported that the water parameter of TDS, TS, TSS are gradually increased from sample 2 to sample 3 due to the enzymatic activities and biodegradation of the water.

pH

The pH (Potentia Hydrogeni) is most significant property of water. It refers to its hydrogen ion activity and is expressed as the logarithm of the reciprocal of the hydrogen ion activity at a given temperature. pH is measured in scales of 0 to 14. A pH value of 7 is neutral; a pH less than 7 is acidic and greater than 7 represents base saturation or alkalinity (Dahl, 1927). The pH of the water samples ranged from 6.5 to 7.8 is suitable for crops cultivation by (Shivanna, 2014).

In the present study pH of the water sample1, 2 and 3 obtained were 7.3, 6.5 and 7.1. The pH after two weeks of idol immersion highest and was recorded as 6.5 and the water is alkaline in nature which shows high pollution and stress for aquatic animals. The results were in accordance with the observation made by Prasa, (1985). who attributed higher values of total alkalinity to polluted condition of water after idol immersion. This condition comes to normal after one or two months due to the interaction between water and soil in the ponds, sea, rivers and lakes. From this study the water sample before and after two months of idol immersion the pH level is suitable for crop cultivation and favorable for fish growth (Boyd, 1978).

Alkalinity and total hardness

From this observation alkalinity and total hardness sample 1, showed 175 and 173 which decrease and were sample 2, recorded 182 and 163 which declines. The water sample 3, obtained 115 and 172, which raises. This investigation similar with Abbasi, 2013. Who reported that idol immersion after idol immersion decreases the water alkalinity and total hardness due to clay metabolisms. This observation showed that sample 1 and sample 3 water was contained the high level of alkalinity and total hardness. Thus, it influencing good water quality and plankton growth.

DO Content

Khillare and Snowane,(1990) was reported then the measurement of DO indicates the purity of water. Depleted dissolved oxygen content is more significant in metal pollution. DO content due to decomposition of organic matter was observed by Das and Verma, (1993). Dissolved oxygen levels in water bodies indicate its ability to support aquatic fauna, rate of oxygen and quality of water. Dissolved oxygen levels between 4.5 to 5.3 mg/L are satisfactory for survival and growth of organism.

In the present study DO the samples 1, 2 and sample 3 was recorded 5.3, 4.5 and 5.1 mg/l. From this observation the sample 2 shows very low DO level in water, after two weeks of idol immersion. The progressive increases of DO from sample 2 to sample 3 due to biodegradation and biomass of the water. (Ragi reddy, 2017). Suggested the low leave of DO affected the aquatic animals planktion. Hence in the Muthannankulam low DO level in sample 2 is not suitable aquatic animals and planktons.

BOD and COD

Organic pollutants, which are susceptible to oxidation by strong chemicals, are measured in the form of chemical oxygen demand and those are susceptible to oxidation by biological matter are measured in the form of biological oxygen demand (Roshan *et al*., 1992).

In the present study BOD and COD in water sample 1, was 15.8 and 295 mg/l in the sample 2 ,the leave was13.3 and 280 mg/l which lowers and sample 3, showed 14.5mg/l and 284 mg/l raised of BOD and COD levels in the water. The investigation coincide with the findings of Chandra Sarma, 2015. Who reported that idol immersion increases the water BOD and COD which comes to normal range after the action of enzymatic reaction in water and climatic condition.

Chlorides and sulphate

Trivedi (1978) was reported the chloride and sulphate content naturally found in water. The moderate level of chlorides and sulphate are beneficial and higher concentration indicates pollution due to industrial waste. Chloride and sulphate content of water was assessed as per the standard methods. High chloride and sulphate value indicates pollution of water sediment due to urbanization, industrialization and modernization in agricultural system results in extensive use of chemical fertilizers and pesticides (Anu *et al.,* 2010).

In the present study, chlorides and sulphate of water sample 1, recorded maximum level (198 and 107mg/l). Next to water sample 1, the minimum level were obtained in water sample 2 of chloride and sulphate (192 and 123 mg/l) and moderate level were observed in water sample 3 (180 and 115 mg/l. amoung the 3 sample, 2 denoted higher concentration of chloride and sodium values. The results coherence with Parbhani, (2007). He reported that sulphate and chlorides in water increased after idol immersion and comes to normal level after 50- 100 days due to biosynthsis of the water.Vikas singh, (2013) was reported that chlorides and sulphate used more amount for making the platser of paris during chadhurthi and holi festivals. From this observation the water sample 2 showed low nutrient properties and plant growth .

Nitrate Nitrogen, Phosphate and Lead

In the present study nitrate nitrogen, lead and phosphate before idol immersion(0.028, 0.042and 0.0234mg/l) increase and after two weeks of idol immersion is decreases (0.032,0.048, 0.242kg/ha) in the water. The water sample 3, after two months of idol immersion showed 0.025, 0.025 and 0.038(kg/ha). The similar investigation made by Subbiah and Asija, (1856). And reported that after two weeks of idol immersion decreases nitrate nitrogen, phosphate and lead which comes to normal after two months due to the action of clay and decomposition of water.

In the present study showed sample 1 and sample 3 of Muthannankulam water is useful for Photosynthesis, nitrogen fixation, crop maturation, root development, photosynthesis, protein synthesis, starch formation, translocation of sugars and sample 2 is not suitable for plant growth and aquaculture. After two moths of idol immersion, the nutrient level is increased and suitable for plant growth.

Nickel and chromium

Nickel and chromium serve as plant nutrients. In clay the Nickel and chromium possess excellent physical conditions. It allow free movement of water without stagnation and contains sufficient air for the proper aeration of plant roots. Such a water is highly productive it supplies necessary plant nutrients (Nelson *et al.*, 1982).

In the present experiment Nickel and chromium of the sample 1, recorded highest level 2.40 and 0.008 mg/l. Sample 2 obtained minimum level 2.35 and 0.012 mg/l and moderate level observed in water sample 3, 2.370 and 0.005 mg/l. Due to photosynthesis, biogradation and organic decomposition of water decreases after two weeks of idol immersion which after two month The gradual increases of nickel and chromium level from sample 2 to sample 3 was due to the action of photosynthesis and biogradation of water.

4.5 MICROBIAL ANALYSES

The population of bacterial and fungi colonies in water of Muhannankulam water was observed in this study. The bacterial colonies in sample 1 was observed as 3×10^{-8} CFU/ml which decreased and number of bacterial colonies in sample 2 was recorded as 64×10^{-8} CFU/ml. Similar observation was made by Ogunmwony et.al. (2008) and reported that the number of growth of bacterial colony in the water sample 2 indicates the contamination of water. The bacterial population in sample 3 was 23×10^{-8} CFU/ml The result is in accordance with the observation made by Mclean, (1982) and reported that the number of bacterial colony increased in sample 2 was due to the intraction of harmful chemicals. The bacterial colonies were decreased in the sample 3 after two months of idol immersion was due to decomposition or biosynthesis of the water.

The number of fungi colonies in sample 1 was analysed as 2×10^{-8} CFU/ml which increased in sample 2 and was reported as 75×10^{-8} CFU/ml . This investigation coincide with the findings of Olayinka *et al.*, (2011). He reported that growth of fungi increases due to some faecal contamination in the water. In the present study fungi population in sample 3 was 35×10^{-8} CFU/ml which showed decreased level than the sample 2. The similar observation made by Anderson and Domsch,(1989) who reported that the fungi population in water raises or lowers which depends upon the presence of heavy metals and changes of condition in the water.

6. SUMMARY AND CONCLUSION

- The results of the present study on “Impact of idol Immersion in the water quality of Muthannankulam, Coimbatore” is summarized and presented in this chapter:
- The water samples were collected in Muthannankulam before, after two weeks and after two months of idol immersion were analyzed for physical parameters (EC, temperature, TDS, TSS, TS colour order), chemical parameters (pH, alkalinity, BOD, COD, DO, phosphate, sulphate, lead, total hardness, chlorides, chromium, nitrate nitrogen and nickel)and microbial analyses (bacteria and fungi colonies count).
- physical parameters EC, temperature, TDS,TSS,TS were analyzed in sample 1 (before idol immersion) and reported as 1020 µmho/cm, 27^{O}C, 1507 mg/l, 100 mg/l and 1900 mg/l, all the values were within the BIS limits.
- The chemical parameters pH, alkalinity, BOD, COD,DO phosphate ,sulphate, chromium, chlorides, nitrate nitrogen and lead were analyzed in sample 1 before idol immersion and reported as 7.3,175mg/l, 13.3mg/l, 295 mg/l, 0.042mg/l, 107 mg/l,0.008 mg/l ,450 mg/l, 0.234 mg/l and all the values were within the BIS limit
- The microbial analysis of the enumeration of bacteria and fungi in the sample 1 was low and the bacterial count was 2×10^{-8} CFU/ml and fungal colony was 2×10^{-8} CFU/ml .
- The physical parameters EC, temperature, TDS,TSS,TS were analyzed in sample 2 (after 2 weeks of idol immersion) and reported as 1015 µmho/cm, 25.2^{O}C, 1460 mg/l, 182 mg/l and 1775 mg/l all the values were less than the BIS limits.
- The chemical parameters pH, alkalinity, BOD, COD,DO phosphate ,sulphate, chromium, chlorides, nitrate nitrogen and lead were analyzed in sample 2 after 2 weeks idol immersion and reported as 6.5,182 mg/l, 13.3 mg/l, 280 mg/l, 5.0mg/l, 0.048 mg/l,123 mg/0.012 mg/l, 0.242 mg/l ,and all the values were within the BIS limit.
- The microbial analysis of the enumeration of bacteria and fungi in the sample 2 was high and the bacterial count was 23×10^{-8} CFU/ml and fungal colony was 75×10^{-8}CFU/ml .

- The physical parameters EC, temperature, TDS, TSS, and TS were analyzed in sample 3 (after 2 months idol immersion) and reported as 101 µmho/cm, 26.3^{O}C, 1490 mg/l, 115 mg/l ,and 1800mg/l all the values were within the BIS limits.
- The chemical parameters pH, alkalinity, BOD, COD, DO, phosphate ,sulphate, chromium, chlorides, nitrate nitrogen and lead were analyzed in sample 3 after 2 months idol immersion and reported as 7.1, mg/l, 115 mg/l, 14.5 mg/l 284 mg/l, 4.5 mg/l 0.038 mg/ 115 mg/l, 0.005 mg/l, 180 mg/l ,0.025mg/l and all the values were within the BIS limits but increased from sample 1.
- The microbial analysis of the enumeration of bacteria and fungi in the sample 3 was increased and bacterial count was 25 x 10^{-8} CFU/ml and fungal colony was 6 x 10^{-8}CFU/ml.
- From the study it could conclude that physicochemical and microbial analysis of Muthannankulam before idol immersion showed high nutrient content and is favourable for aquatic animals and plant growth. The physiochemical and microbial analysis after two weeks of idol immersion has reduces nitrogen fixation, photosynthsis, decomposition of the water. But after 2 months it regains nutrients and suitable for plant growth aquatic animals. The Government has creating awareness to make people to realize that the importance of Nature and spreading awareness of Ganesh chathurthi effects on the environment. The guideline given by government for idol immersion are mentioned below:
- Idols should be made from natural materials such as clay, plaster of Paris, etc. may be encouraged, allowed and promoted.
- Painting of Idols should be discouraged. In case idols are to be painted, water soluble and nontoxic natural dyes should be used. Use of toxic and non-biodegradable chemical dyes for painting idols should be strictly prohibited.
- Worship material like flowers, vastras , decorating material (made of paper and plastic) etc. should be removed. Biodegradable materials should be collected separately for recycling or composting. Non-biodegradable materials should be collected separately for disposal in sanitary landfills.

Since water is one of the most important substances on earth.All plants and animal must have water to survive. It is evidently clear that water is one of the prime elements responsible for life on earth. Hence, from the present study it can be concluded that Public should be educated on ill effects of idol immersion in the holy water bodies through mass awareness programmer. The public should follow the guidelines of government in order to minimize the pollution in water bodies during idol immersion.

"A drop of water is worth more than a sack of gold to a thirty man".

So save water and save nation

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3.1 PHYSICOCHEMICAL CHARACTERIZATION OF THE WATER SAMPLES

3.3.1 PHYSICAL PARAMETERS

1. Colour

The colour of the sample was visually observed.

2. Odour

The odour of the sample was noted by directly smelling the sample.

3. Electrical conductivity

The Electrical conductivity was estimated using conductivity bridge and expressed in µmhos/cm.

4. Temperature

Temperature was measured at the sampling station itself, using mercury filled centigrade thermometer (0° C to 50° C). The readings were made by dipping the thermometer in samples for 2 minutes before constant readings were obtained.

APPENDIX 1

5. DETERMINATION OF TOTAL SUSPENDED SOLIDS

Principle

A well-mixed sample is filtered through a weighed standard glass-fibre filter and the residues retained on the filter are dried to a constant weight at 103℃ – 105℃. The increase in weight of the filter represented the total suspended solids. If the suspended material clogs the filter and prolongs filtration, it may be necessary to increase the diameter of the filter or decrease the sample volume.

Procedure

Suspended solids of the sample were estimated by centrifugation method. 50 ml of the sample was centrifuged and after centrifugation the residue was washed with distilled water, recentrifuged and the suspended solids in the centrifuge tube was transferred to a pre weighed silica dish and dried at 105° C. The increase in weight was equal to the amount of suspended solids. The suspended solids present in the sample were calculated by using the formula.

$$\text{Total suspended solids in mg/l} = \frac{\text{Final wt.} - \text{Initial wt. of the crucible}}{\text{Volume of the sample}}$$

APPENDIX 2

6. DETERMINATION TOTAL DISSOLVED SOLIDS

Principle

A well-mixed sample is filtered through a standard glass fiber filter and the filtrate is evaporated to dryness in a weighed dish and dried to constant weight at 180℃. The increase in dish weight represents the total dissolved solids.

Procedure

50 ml of the sample was taken in a pre weighed silica crucible and the sample was evaporated to dryness using a water bath. After complete evaporation the final weight of the crucible was taken. The total dissolved solids present in the sample was calculated by using the following formula

$$\text{Total dissolved solids in mg/l} = \frac{\text{Final wt.} - \text{Initial wt. of the crucible}}{\text{Volume of the sampl}} \times 1000$$

APPENDIX 3

7. TOTAL SOLIDS

Calculation

Mg/l total solids (TS) = mg/l total suspended solids (TSS)+ mg/L total dissolved solids(TDS)

3.3.2. CHEMICAL PARAMETERS

APPENDIX 4

8. DETERMINATION OF PH

Principle

A glass surface in contact with hydrogen ions of the solution under test, acquires an electrical potential which depends on the concentration of H^+ ions. A measure of the electrical potential (emf), gives H^+ ion concentration or pH of the solution.

Procedure

A direct reading pH meter was used. The pH meter was first standardized using buffer solutions of pH 7.0 and pH 9.2. The electrodes were rinsed in distilled water and immersed in the textile effluent samples and readings were noted in the digital display.

APPENDIX 5

9. Estimation of Alkalinity

Principle

When a sample containing carbonate and bicarbonate are titrated against the standard sulphuric acid, phenolphthalein loses its pink colour when half of the carbonate is converted to bicarbonate. Twice this value is a measure of carbonates present in the sample.

To the colourless solution, a few drops of methyl orange is added and titrated against sulphuric acid till straw yellow colour changes to pinkish red colour. This value gives the amount of acid required to neutralize the bicarbonate originally present and that from the carbonates. By subtracting the first titre value from the second one, acid required to neutralise the bicarbonate originally present in the sample is obtained.

Reagents

1. **Sodium carbonate solution 1N:** 13.25g was dissolved in 250ml water.
2. **Sulphuric acid 1N:** 28ml of conc. sulphuric acid was made up to a litre with distilled water.
3. **Sulphuric acid 0.02N:** Diluted approximate volumes of 1N sulphuric acid to prepare 0.02N sulphuric acid= 1.0mg $CaCO_3$.
4. **Phenolphthalein indicator:** 500mg of phenolphthalein was dissolved in 50ml of ethyl alcohol and 50ml of distilled water. 0.25N sodium hydroxide solution was added drop wise until a faint pink colour appeared.
5. **Mixed indicator solution:** 20mg of methyl red and 100mg of bromocresol green were dissolved in 100ml of 95% isopropyl alcohol.

Procedure

To 50ml of the effluent equal volume of distilled water and a pinch of phenolphthalein indicator solution was added in a 250ml conical flask. Pink colour appeared which was then titrated with 0.02N sulphuric acid until the solution become colourless. Three drops of mixed indicator solution was added to the solution in which phenolphthalein alkalinity had been determined and titrated against 0.02N sulphuric acid. The colour was changed from emerald green to light pink. (If no pink colouration occurred, it indicated nil phenolphthalein alkalinity).

Calculation

$$\text{Total alkalinity as CaCO3 (mg/l)} = \frac{\text{ml of 0.02N } H_2SO_4 \text{ for total alkalinity end point} \times 50 \times 0.02 \times 1000}{\text{ml sample taken for titration}}$$

APPENDIX 6

10. ESTIMATION OF TOTAL HARDNESS

Principle

Ethylene diamine tetra acetic acid and its sodium salts (EDTA) form a chelated soluble complex when added to a solution of certain metal cations. If a small amount of dye such as Eriochrome Black – T or calmagite is added to an aqueous solution containing calcium and magnesium ions at a pH of 10.0 ± 0.1, the solution becomes wine red. If EDTA is added as a titrant, the calcium and magnesium was complexed and the solution turns from wine red to blue, marking the end point of the titration.

Reagents

1. **Buffer solution:** 16.9 g of ammonium chloride and 1.25g of magnesium salt of EDTA is dissolved in 143ml of concentrated ammonium hydroxide and diluted to 250ml with distilled water.

2. **Inhibitor:** 4.5g of hydroxylamine hydrochloride in 100ml of 95% ethanol.
3. **Eriochrome Black– T indicator:** 0.5 g of the dye was mixed with 100g of Sodium chloride to obtain a dry powder mixture.

4. **Standard EDTA titrant (0.02 N):** 3.723g Disodiumethylene diamine tetraacetate dihydrate was dissolved in 1 litre of water. It was standardized against standard calcium solution. 1.0 ml of 0.02 N EDTA ≡ 1.0 mg of $CaCO_3$.

5. **Standard calcium solution:** 1.0g of pure calcium carbonate was dissolved in 1 litre of distilled water using 20.5ml of HCL and the contents were warmed. 1.0ml= 1mg $CaCO_3$.

Procedure

1. 50 ml of water sample was taken in a conical flask and 2ml of buffer solution and 1ml of the inhibitor were added.
2. After adding a pinch of Eriochrome Black– T indicator it was titrated against standard EDTA, till the wine red colour changed into blue. The volume of EDTA used was noted.

Calculation

$$\text{Total Hardness as } CaCO_3 \text{ (mg/l)} = \frac{\text{ml EDTA titrant} \times 1 \times 1000}{\text{Volume of sample taken for estimation}}$$

APPENDIX 7

11. ESTIMATION OF DISSOLVED OXYGEN

Dissolved oxygen of the water sample was estimated by Winkler's method.

Reagents:

1. **Manganese sulphate:** 480g of manganous sulphate tetrahydrate is dissolved and made up to 1000ml with distilled water (Discarded if it changes colour with starch).

2. **Alkaline iodide-azide reagent:** 500g of sodium hydroxide and 150g of potassium iodide along with 10g of sodium azide (NaN3) is dissolved and made up to 1000ml with distilled water.
3. Conc. sulphuric acid
4. **Starch indicator:** 0.5g of starch is dissolved in distilled water and boiled for few minutes.
5. **Stock sodium thiosulphate:** 24.82g of sodium thiosulphate pentahydrate (Na2S202. 5H2O) is dissolved in distilled water and made up to 1000ml.
6. **Standard sodium thiosulphate (0.025N):** 250ml of the stock sodium thiosulphate pentahydrate is made up to 1000ml with distilled water to give 0.025N.

Procedure:

The samples are collected in BOD bottles, to which 2ml of manganous sulphate and 2ml of potassium iodide are added and sealed. This is mixed well and the precipitate allowed settling down. At this stage 2ml of conc. sulphuric acid is added, and mixed well until all the precipitate dissolves. 203ml of the sample is measured into the conical flask and titrated against 0.025N sodium thiosulphate using starch as an indicator. The end point is the change of colour from blue to colourless.

Calculations

203ml because (200) (300)/ (200-4) = 203ml.

1ml of 0.025N Sodium thiosulphate = 0.2mg of Oxygen

Dissolved Oxygen (as mg/L) $= \frac{(0.2)(1000 \text{ ml of sodium thiosulphate})}{200}$

APPENDIX 8

12. Estimation of Biochemical Oxygen Demand (BOD)

Principle

BOD determination involves the measurement of dissolved oxygen content of the sample, before and after 5 days incubation at 20°C. The reduction in oxygen content is due to the demand exerted by the microbiological population and it is a measure of oxidisable organic matter in the sample.

When manganous sulphate is added to the sample containing potassium iodide, manganous hydroxide is formed, which is oxidized by the dissolved oxygen of the sample to basic manganic oxide. On addition of sulphuric acid, the basic manganic oxide liberates iodine, equivalent to that of dissolved oxygen originally present in the sample. The liberated iodine is titrated with a standard solution of sodium thiosulphate using starch as indicator.

Reagents

1. **Phosphate buffer solution:** 33.4g disodium hydrogen phosphate, 8.5g potassium dihydrogen phosphate, 21.75 g dipotassium hydrogen phosphate, 1.7 g ammonium chloride in 1000 ml of distilled water in a volumetric flask and pH was adjusted to 7.2.
2. **Dilution Water:** Double distilled water taken in a glass container was aerated for half an hour using an aerator. 1 ml of phosphate buffer, 1 ml of M_gSO_4 (22.5 g/l) 1 ml of $CaCl_2$ (27.5 g/l) and 1 ml of $FeCl_3$ (0.25 g/l) were added.

Procedure

1. Water sample was diluted (measured dilution) with dilution water (Dilution is not necessary for unpolluted waters and seeding is unnecessary for surface waters).

2. Water sample was taken in two BOD bottles. D.O content (D1) of one bottle was analysed and the other was incubated in BOD incubator at 20° C for 5 days.

3. Two other bottles were filled with dilution water D.O content was analysed immediately in one bottle and the other was incubated.

4. D.O was analysed in the incubated water sample (D2) and dilution water after 5 days of incubation.

Calculation

$$\text{BOD (mg/l)} = \frac{(D1 - D2 - BC) \times 100}{\text{Percentage dilution of sample}}$$

BC – Blank Correction

Appendix 9

13. Estimation of Chemical Oxygen Demand (COD)

Principle

Chemical Oxygen Demand (COD) is defined as the amount of a specified oxidant that reacts with the sample under controlled conditions. The quantity of oxidant consumed is expressed in terms of its oxygen equivalence. Because of its unique chemical properties, the dichromate ion ($Cr_2O_7^{2-}$), the specified oxidant is reduced to the chromic ion (Cr^{3+}).

COD often is used as a measurement of pollutants in waste water and natural waters. Most types of organic matter are oxidized by boiling the mixture of chromic and sulfuric acids. A sample is refluxed in strongly acid solution with a known excess of potassium dichromate. After digestion, the remaining unreduced potassium dichromate is titrated with ferrous ammonium sulfate to determine the amount of potassium dichromate consumed and the oxidizable matter is calculated in terms of oxygen equivalent.

Reagents

1. Standard potassium dichromate solution (0.250M): 12.25g of potassium dichromate dried at 103°C for about 2 hours is dissolved in distilled water and made up to 1000ml.

2. Standard ferrous ammonium sulphate (FAS) 0.25N: 98g of FAS is dissolved in minimum distilled water to which 20ml of conc. sulphuric acid is added and made up to 1000ml using distilled water to give 0.25N of ferrous ammonium sulphate.

3. Ferroin indicator: 1.485g of 1,10-phenanthroline monohydrate and 695mg of ferrous sulphate is dissolved in 100ml of distilled water.

4. Conc. sulphuric acid

5. Silver sulphate crystals

6. Mercuric sulphate crystals

Procedure

15ml of conc. sulphuric acid with 0.3g of mercuric sulphate and a pinch of silver sulphate along with 5ml of 0.025M potassium dichromate is taken into a Nessler's tube. 10ml of sample (thoroughly shaken) is pipetted out into this mixture and kept for about 90 minutes on the hot plate for digestion. 40ml of distilled water is added to the cooled mixture (to make up to 50ml) and titrated against 0.25M FAS using ferroin indicator, till the colour turns from blue green to wine red indicating the end point. A reagent blank is also carried out using 10ml of distilled water.

Calculations

$$\text{COD (mg/l)} = \frac{\text{Blank reading - Sample reading) X N X F X 1000}}{\text{Sample taken, ml}}$$

To calculate F,

$$F = \frac{10000}{\text{Titre value of blank}}$$

APPENDIX 10

14. ESTIMATION OF CHLORIDES

The amount of chlorides was estimated by silver nitrate titrimetric method.

Principle

Silver nitrate reacts with chloride ions to form silver chloride. The completion of reaction is indicated by the red colour produced by the reaction of silver nitrate with potassium chromate solution which is added as an indicator.

Reagents

1. **Potassium chromate indicator:** 25 g of potassium chromate was dissolved in 100 ml of distilled water. Silver nitrate solution was added till a definite precipitate was formed. After 12 hours the solution was filtered and diluted to 500 ml with distilled water.

2. **0.0282 N silver nitrate solution:** 4.791 g of $AgNO_3$ in 1000 ml of distilled water. The
solution was standardized against 0.0282 N sodium chloride.

3. **0.0282 N sodium chloride:** 1.648 mg of sodium chloride in 1000 ml of distilled water.

Procedure

1. 50 ml of sample was taken and pH was adjusted between 7.0 and 8.0.

2. 50 ml of this sample was taken and 1 ml of potassium chromate was added.

3. The sample was titrated against standard $AgNO_3$ solution taken in a burette until a brick red precipitate was formed and the volume used was noted.

Calculation

$$\text{Chlorides (mg/l)} = \frac{V \times N \text{ of } AgNO_3 \times 35.45 \times 1000}{\text{Volume of the sample}}$$

APPENDIX 11

15. ESTIMATION OF SULPHATE

Gravimetric method was used for the estimation of sulphate.

Principle

Sulphate ions are precipitated as barium sulphate crystals of uniform size in acid medium. Light absorbed by the precipitate is measured using a spectrophotometer.

Reagents

1. **Methyl red indicator:** 50 mg methyl red indicator in 50 ml distilled water.
2. **Barium chloride solution:** 100 g of barium chloride was dissolved in 1000 ml of distilled water and was filtered through Whatmann N0.1 filter paper.
3. **Silver nitrate solution:** 0.5 ml conc. HNO_3 and 8.5 ml $AgNO_3$ in 500 ml distilled water.
4. **Hydrochloric acid (50%):** Hydrochloric acid and distilled water in 1:1 ratio.

Procedure

1. To 100 ml of sample in an Erlenmeyer flask, 2-3 drops of methyl red indicator was added.

2. pH was adjusted to about 4.5 to 5.0 by adding Hydrochloric acid until the colour was changed from red to orange. 2 ml of HCl was added in excess.

3. The solution was boiled and warm barium chloride was added slowly until the precipitation was completed. The solution was heated in water bath for 2 hours and filtered through Whatman No. 42 filter paper.

4. The precipitate was washed with warm distilled water until the filtrate showed no traces of chloride. It was tested by adding $AgNO_3$ solution. Absence of white turbidity on addition of $AgNO_3$ indicated the absence of chlorides.

5. The filter paper with precipitate was dried in an oven at 105° C for an hour, and weighed.

Calculation

$$\text{Sulphate (mg/l)} = \frac{\text{Wt. of precipitate in mg. X 0.4116}}{\text{Volume of sample taken}} \text{ X 1000}$$

APPENDIX 12

16. ESTIMATION OF PHOSPHATES

The amount of phosphate was estimated by stannous chloride method.

Principle

Ammonium molybdate reacts with phosphate to form molybdophosphoric acid which is reduced to a blue coloured complex (molybdenum blue) by the addition of stannous chloride.

Reagents

1. **Phenolphthalein indicator solution:** 500 mg of phenolphthalein was dissolved in 50 ml of ethyl alcohol and 50 ml of distilled water was added.
2. **Sulphuric acid – nitric acid solution:** 75 ml Conc. H_2SO_4 was added to about 150 ml. distilled water and cooled. 1 ml conc. HNO_3 was added and diluted to 250 ml with distilled water.
3. **Ammonium molybdate solution:** 2.5 g ammonium molybdate was dissolved in about 200 ml. distilled water.280 ml conc. H_2SO_4 was added to 400 ml distilled water and cooled. Molybdate solution was added to the diluted acid and dilute to 1000 ml.
4. **Stannous chloride solution:** 2.5 g fresh stannous chloride was dissolved in 100 ml glycerol and heated in a water bath.
5. **Phosphate stock solution:** 439 mg potassium dihydrogen phosphate was dissolved in distilled water and made up to 1000 ml in a volumetric flask. Two drops of toluene was added as a preservative.
6. **Phosphate standard solution:** 10 ml phosphate stock solution was pipetted into a 1000ml volumetric flask and made up to the mark with distilled water and should be prepared freshly.1.0 ml ≡ 1 mg P

Procedure

1. 50 ml of the sample was taken in a Nessler tube and 1 drop of phenolphthalein indicator was adeed. The pink colour developed was destroyed by adding one or two drops of Sulphuric – nitric acid solution.

2. Phosphate working solution was pipetted in to a series of 100 ml Nessler tubes covering the range up to 20 µg P and made up to 100 ml with distilled water. A Nessler tube containing 100 ml distilled water was kept as a blank.

3. To the blank, standards and sample 4 ml ammonium molybdate solution and 0.5 ml stannous chloride solution were added.

4. Between 10 – 12 minutes the colour developed was measured at 690nm against the reagent blank using a spectrophotometer.

5. A calibration curve was prepared and amount of phosphate equivalent to the observed optical density was calculated and the result was expressed as mg phosphate per litre of sample.

Appendix 13

17. Estimation of Nitrate nitrogen

Principle

Nitrates react with phenoldisulphonic acid and produce a nitrate derivative, which in alkaline solution develops yellow colour due to rearrangement of its structure. The colour produced is directly proportional to the concentration of nitrates present in the sample.

Reagents

Nitrate stock solution

722 mg potassium nitrate was dissolved in distilled water and made up to 1000 ml in a volumetric flask.

Nitrate standard solution

100 ml nitrate stock solution was pipetted in to a 1000 ml volumetric flask and made up to the mark with distilled water.

Brucine – Sulphanilic acid solution

1 g brucine sulphate and 100 mg sulphanilic acid was dissolved in 70 ml hot distilled water 3 ml conc. HCl was added cooled and diluted to 100 ml with distilled water.

Sulphuric acid solution

500 ml conc. H_2SO_4 was added to 75 ml distilled water and cooled to room temperature.

Procedure

1. 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5 and 5.0 ml of nitrate standard solution were taken in a series of 50 ml beakers and diluted to 5 ml with distilled water.
2. A beaker containing 5 ml of distilled water was used as a blank.
3. 2 ml of the sample was taken in a 50 ml beaker and diluted to 5 ml with distilled water. 1 ml of brucine sulphanilic acid solution was added to the blank, standards and sample are mixed well.
4. 10 ml of Sulphuric acid solution was taken in a second series of 50 ml beakers. The contents of the first series of beakers were poured in to each of the second series of beakers and mixed well. Beakers were kept in the dark for 10 minutes.
5. 10 ml of distilled water was added to all the beakers. Beakers were allowed to cool for 20 – 30 minutes. The colour development was read in a colorimeter against 510 nm. Using the calibration curve the mg. equivalent of nitrate nitrogen in the sample was found out.

Calculation

$$\text{Nitrate (mg/l)} = \frac{\text{mg. Nitrate X 1000}}{\text{ml. Sample taken for estimation}}$$

APPENDIX 14

18. ESTIMATION OF LEAD

Principle

Lead can be determined at a wavelength of 283.3 nm by AAS with aspiration of the sample into the oxidising air-acetylene flame. When the aqueous sample is aspirated, the sensitivity for 1% absorption is 0.5 mg/L and the detection limit is 0.05 mg/L.

Reagents

1. **Ammonia solution, approximately 0.5N:** Dilute 3.5ml ammonia solution to 100ml with water.
2. **Dithizone stock solution, 0.1% (in chloroform):** keep it in an amber bottle and store in a refrigerator.
3. **Dithizone working solution (in water):** Transfer 12ml of stock dithizone solution into a 100ml sepersting funnel. Add 20ml 0.5N. ammonia solution and shake well. Allow the phases to separate and reject the lower chloroform layer. Filter the aqueous layer through a wetted filter paper (to remove droplets of chloroform) in to a 50ml amber bottle.
4. **Sodium hexameta phosphate solution 10%:** Dissolve 10g sodium hexameta phosphate in 100ml distilled water. Remove traces of lead by extraction with stock dithizone solution (0.1% chloroform solution) after adjusting the pH to 9 with conc. Ammonia solution. Acidify the aqueous layer in the separating funnel using 1+1 HCl and then extract with chloroform to remove free dithizone until the chloroform layer becomes colourless. Reject the chloroform layer. Adjust the pH of the aqueous solution to 9.5.
5. **Hydroxyl- amine hydrochloride solution 1%:** Dissolve 1g. of NH_2 OH. HCl in 100ml distilled water.
6. **Alkaline cyanide solution:** prepare a mixture of solution containing 340ml. ammonia (sp. gr 0.88) and 680ml water. Dissolve 3.0g sodium sulfite Na_2 SO_3.

$7H_2O$ in the mixture. Add 30ml 1% potassium cyanide solution and mix well. Keep it in a tightly stoppered bottle.

7. **Lead stock solution:** Dissolve 1.599g lead nitrate, Pb $(NO_3)_2$ in small amount of water. Add 10ml conc. Nitric acid and make up to 1000ml. 1ml= 1.0mg. Pb
8. **Lead intermediate solution:** dilute 10ml of the above lead stock solution to 1000ml. with distilled water (prepare freshly). 1.0ml= 10µg. Pb
9. **Lead working solution:** Dilute 10ml of the lead intermediate solution to 100ml. with distilled water (prepare freshly). 1.0ml= 1.0µg. Pb

Procedure

Standards

1. Place 50ml. of lead free distilled water in to a series of short stem separating funnels. Pipet 0.0, 1.0, 2.0, 3.0, 4.0……10.0ml of lead working solution in to them.

2. Add the following reagents in order with shaking after each ccondition, (i) 1.0ml sodium hexametaphosfate solution, (ii) 1.0ml hydroxylamine hydrochloride solution, (iii) 30ml alkaline cyanide solution, (iv) 0.5ml dithizone working solution and (v) 10ml chloroform.

3. Shake the funnel vigorously and allow the layers to separate. Dry the stem of the funnel with filter paper strips. Draw the chloroform layer in the optical cell.

4. Measure the optical densities using a spectrophotometer at 540nm or filterphotometer with a green filter using a 10mm cell, plot a calibration curve.

APPENDIX 16

20. Estimation of nickel

The amount of nickel was estimated by dimethyl glyoxime method.

Principle

Nickel reacts with dimethyl glyoxime in the presence of an alkaline oxidising agent to form a characteristic red colour complex which can either be measured visually or photometrically.

Interferences

Iron, manganese and copper interfere and if they are present in concentration thrice that of nickel, their interference is suppressed by the addition of sodium citrate. If they are present in excess concentrations, nickel dimethyl glyoxime complex alone is separated by extraction with chloroform and preceded further.

Reagents

Nickel stock solution

447.9 mg Nickel sulfate ($NiSO4.6H2O$) was dissolved in distilled water and the volume was made upto 1000 ml. in volumetric water (1.00 ml = 100μg Ni).

Nickel working solution

10.0 ml of nickel stock solution was pipetted into a 100 ml volumetric flask and made upto the mark with distilled water (1.00 ml = 10 μg Ni).

0.5N Hydrochloric acid

50ml conc. HCl was diluted to 1000 ml with distilled water

Sodium citrate solution

125g sodium citrate was dissolved in 500 ml distilled water.

0.05 N Iodine solutions

20g potassium iodide, was dissolved in 5 ml. distilled water. 6.4 g iodine was dissolved in this solution, and the solution was diluted to 1000 ml.

Dimethyl glyoxime solution

1g dimethyl glyoxime was dissolved in 100 ml of concentrated ammonia solution. 100 ml distilled water was added and filtered if necessary.

Additional reagents for the removal of interferences

Dilute ammonia solution - 10 ml. concentrated ammonia solution was diluted to 500ml with distilled water.

Chloroform

Procedure

1. Appropriate volumes of nickel working solution covering the range up to 100 μg was taken in a series of 50ml Nessler tubes. 50 ml Nessler tube with distilled water was kept as the blank.

2. A suitable aliquot of the neutralised (acid digested sample containing not more than 100 μg nickel) was taken in a 50ml Nessler tube.

3. To the blank, standards and sample 20 ml of 0.5 N. HCl was added.

4. Then following reagents were added in order with mixing after each addition:

(i) 10 ml. sodium citrate solution

(ii) 2 ml. iodine solution and

(iii) 4 ml. dimethyl glyoxime solution

5. The volume in all the flasks were made upto 50 ml. with distilled water and allowed to stand for 20 minutes.

6. Optical density was measured in a spectrophotometer at 470 nm against the reagent blank. A calibration curve was prepared and the microgram of nickel equivalent to the observed optical density was determined. The result was expressed as mg nickel per litre of the sample.

APPENDIX 17

21. Estimation of chromium

Principle

Under acidic conditions, hexavalent chromium reacts with s- diphenyl carbazide to form a reddish violet colored complex which can be determined either visually or photometrically.

Reagents

1. Chromium stock solution: Dissolve 283mg dried potassium dichromate in distilled water and make up to the mark with distilled water. 1.0ml= 100µg Cr

2. Chromium working solution: pipette 10ml chromium working solution into a 500ml volumetric flask and make up to the mark with distilled water. 1.0ml= 2.0µg Cr

3. Sulfuric acid: 5%- carefully add 50ml conc. H_2SO_4 to 950ml distilled water and cool.

4. Phosphoric acid, 85%

5. Diphenyl carbazide solution: Dissolve 500mg s- diphenyl carbazide and 8g phthalic anhydride in 200ml. 95% ethyl alcohol. Keep it in a refrigerator.

Procedure

1. Place appropriate volumes of chromium working solution in 50ml volumetric flasks or nesslers tube containing 25ml distilled water as the blank.

2. Place 25ml or an aliquot (containing not more than 50µg. Cr) of the neutralized sample in a volumetric flasks or nesslers tube.

3. To the blank, standards and sample add the following reagents were added in order with mixing after each addition:

(i) 10ml. 5% sulfuric acid

(ii) 0.4ml. Phosphoric acid and

(iil. i) 4ml Diphenyl carbazide solution.

4. Dilute to the mark with distilled water, mix well and set aside for 5minutes.

5. Measure the optimal densities of the blank, standards and sample using a spectrophotometer at a wavelength of 540nm taking water as the reference.

6. Prepare a calibration curve. Find out the mg. Cr equivalent to the observed optical density.

3.3.3 MICROBIAL ANALYSIS

These are the tests or steps which were followed for analysis and identification of bacteria.

ENUMERATION OF BACTERIA FROM WATER

REAGENTS REQUIRED

Nutrient agar medium and muller hinton agar medium.

PROCEDURE

Water sample was collected aseptically in a sterile glass tube or bottle.

1ml of the sample was added to 9ml of sterile distilled water to get 10^{-1} dilution.

From 10^{-1} dilution 1 ml of the sample was taken and serially diluted up to 10^{-8} dilution.

From each dilution 1 ml of the sample was poured on to the plates and sterilized nutrient agar and mullar hinton agar medium was poured (pour plate) for bacteria and respectively.

The plates were incubated at 37°C for 24 hours for bacteria and at room temperature for 5 days for the colonies were counted.

The colony forming units (CFU) per ml of water sample was calculated

$$\text{CFU / ml. of water sample} = \frac{\text{No. of colonies (Average of three replicates)}}{\text{Amount plated X Dilution factor}}$$

ENUMERATION OF FUNGI FROM WATER

REAGENTS REQUIRED

Nutrient agar medium and rose bengal chloramphenicol agar medium,

PROCEDURE

Water sample was collected aseptically in a sterile glass tube or bottle.

1ml of the sample was added to 9ml of sterile distilled water to get 10^{-1} dilution.

From 10^{-1} dilution 1 ml of the sample was taken and serially diluted up to 10^{-8} dilution.

From each dilution 1 ml of the sample was poured on to the plates and sterilized nutrient agar and rose bengal chloramphenicol agar medium was poured (pour plate) for fungi respectively.

The plates were incubated at 37°C for 24 hours for at room temperature for 5 days for fungi the colonies were counted.

The colony forming units (CFU) per ml of water sample was calculated

$$\text{CFU / ml. of water sample} = \frac{\text{No. of colonies (Average of three replicates)}}{\text{Amount plated X Dilution factor}}$$