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REVIEW ARTICLE

Scope of Complementary Alternative Medicine on the Control of Swine flu – A review

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ABSTRACT

Swine flu is now one of the major infectious diseases which still lack the effective therapeutic strategies. In this paper, we have reviewed the history of the spread, global epidemiology, symptoms and existing treatments. Also present review explores the potential plants for the ideal candidates for the drug discovery for this swine flu. The possible drugs include existing remedial measures as practiced in ayurvedic and homeopathic medicines such as ginger, turmeric, pepper and holy basil. These are the well established antiviral remediation in siddha and ayurvedic medicines, which are reported to successfully control swine flu in few cases. Present review also stresses the importance of these plants on treating swine flu as well as taking as prophylaxis measure.

Key words: Influenza, Swine flu, Alternative medicine, Phytotherapy

INTRODUCTION

Swine flu is an acute respiratory disease of pigs caused by a small spheroid virus that belongs to the Influenza' a 'virus group. Swine influenza is an infection by any one of several types of swine influenza virus. Swine influenza virus is any strain of the influenza family of viruses that is endemic in pigs. As of 2009, the known swine influenza virus strains include influenza C and the subtypes of influenza A known as H1N1, H1N2, H3N1, H3N2 and H2N3. In August 2010 the World Health Organization declared the swine flu pandemic officially over. Influenza A virus was first isolated by Shope in 1931 from swine and by Smith *et al*. in (1933) from humans, approximately 15 years after the 1918 "Spanish". [1-4]

Epidemiology and Symptoms

Recently, RNA sequences of the 1918 influenza virus have been documented by researchers at the Armed Forces Institute of Pathology (AFIP) in Maryland, which had stored specimens of 70 human autopsy cases of the 1918 flu pandemic. In addition, influenza RNA was extracted from a preserved bird from the 1915-1918 stored at the Smithsonian Institution. The work done confirms that the 1918 virus was an H1N1 virus and was closely related to swine and human H1N1 viruses that Swope isolated in the 1930s. However, both 1930 human and swine viruses were genetically distinct from the 1918-era archived wild bird virus from the Smithsonian. Hence, the researchers hypothesize that the virus causing the 1918 pandemic was unlikely transmitted directly from birds to humans or pigs. Rather, they think that the H1N1 pandemic virus likely circulated among swine and/or humans for some period, undergoing drift, before leading to widespread illness in 1918. Over 1438880 peoples are reported to be infected by Swine flu until 2010. Symptoms of swine flu in swine herds include fever, inactivity, nasal discharge, labored breathing, mouth breathing and paroxysmal coughing [5].

All ages are susceptible, mortality rates are generally low and human recover within 5 to 7 days after initial symptoms. The emergence of novel H1N1 has posed a situation that warrants urgent global attention. Though antiviral drugs are available in mainstream medicine for treating symptoms of swine flu, currently there is no preventive medicine available. Even when available, they would be in short supply and ineffective in a pandemic situation, for treating the masses worldwide. Besides the development of drug resistance, emergence of mutant strains of the virus, emergence of a more virulent strain, prohibitive costs of available drugs, time lag between vaccine developments and mass casualties would pose difficult problems. In view of this, complementary and alternative medicine offers a plethora of interesting preventive possibilities in patients. Herbs exhibit a diverse array of biological activities and can be effectively harnessed for managing pandemic flu. Potentially active herbs can serve as effective anti influenza agents. The role of CAM for managing novel H1N1 flu and the mode of action of these botanicals are presented here in an evidence-based approach that can be followed to establish their potential use in the management of influenza pandemics. The complementary and alternative medicine approach deliberated in the paper should also be useful in treating the patients with serious influenza in non pandemic situations [6].

Diagnosis

The diagnosis of swine flu is not easy than other disease diagnosis. The Centers for Disease Control and Prevention (CDC) recommends real time RT-PCR as the method of choice for diagnosing H1N1. This method allows a specific diagnosis of novel influenza (H1N1) as opposed to seasonal influenza. Near-patient point of care tests are in development [8-10].

Current Medicines

For swine flu treatment some medicines are available in market like Relinsa and Tami flu these medicines are discovered just few years ago only but it cures the disease we cannot say these medicine are good targeted medicines in future only we can conclude the efficacy of this medicine.

Complementary and Alternative Medicine for Swine Flu

Many doctors, researchers and scientists prescribe complementary and alternative medicine. A group of diverse medical and health care systems, practices and products that are not presently considered to be part of conventional medicine. Complementary medicine is used together with conventional medicine and alternative medicine is used in place of conventional medicine (CAM) in pursuit of health and well-being. In siddha and auyarvedic methods lot of alternate medicines are available to treat this type of disease. Auyurvedic medicines and plant based medicines are using for swine flu, it has less side effect at the same time it is very safe for human beings. More than 700 plants like Curcumin (*Curcuma longa*), Pepper (*Piper nigrum*), Ginger (*Zingiber officinale*) and Holy Basil (*Ocimum sanctum*) are using for many types of disease [11-13] including swine flu. Curcumin, ginger, pepper, Holy Basil (Tulsi) has lot of antibiotic property, in Indian cultures these compounds are the main ingredients of their foods so naturally they have develop good resistance power it leads to prevent swine flu also. This type of influenza virus mutated easily so the discovery of drug is also difficult in modern days we have lot of advanced system in biology, biotechnology and pharmacology however we cannot say about the drug efficacy in future. We conclude that the complementary alternate medicine from plant based compounds is the only best way to treat swine flu and effective prophylaxis management [14-16]

Conclusion

Ayurvedic, Siddha and homeopathy medicine against major disease is bio friendly alternatives .Its compound are well known for safe and least side effect .The present study was reviewed to find out the better alternative medicine for the swine flu. Number of approaches has been developed for clinical use and drugs have come out for treating this disease .However the toxicity of the drug due to lack of specificity may causes side effect to the person .In conclusion the application of nature products like Curcumin, Pepper, Ginger and Holy Basil etc. in the treatment of swine flu has resulted in therapeutic values. However ancient herbal medicines are need further research to find out the specific compound for treating this kind of viral disease because it has high potential activity than chemical based compounds.

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TABLE 1: Taxonomical status and images of potential plants applicable for the treatment of swine flu

Common Name	**Turmeric**	**Ginger**	**Pepper**	**Holy Basil (Tulsi)**
Kingdom	Plantae	Plantae	Plantae	Plantae
Order	Zingiberales	Magnoliophyta	Piperales	Magnoliopsida
Family	Zingiberaceae	Zingiberales	Piperaceae	lamiales
Genus	*Curcuma*	*Zingiber*	*Piper*	Ocimum
Species	*Curcuma longa*	*Zingiber officinale*	*Piper nigrum*	*Ocimum sanctum*

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RESEARCH ARTICLE

A Case Study of the Karaivetti Birds Sanctuary Wetland with Special Reference to Physico-Chemical Properties of Water and its Environs

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ABSTRACT

The wetland of Karaivetti Lake, located at Ariyalur District, Tamil Nadu, India, covers an area of 454 hectare. This paper advocates habitat conservation and ecological studies with special reference to the physico-chemical characteristics of water. The constituents monitored included Temperature pH, EC, TDS, DO, BOD, Hardness, sodium, Potassium, Calcium, Magnesium, Sulphate, Nitrate, Chloride and Phosphate. A significant variation in these parameters was observed throughout the study period. The pH of the Karaivetti lake water ranged from 6.0 to 9.1, which may be due to the high buffering capacity of the system. The electrical conductivity values ranged from 400 to 700 micromhos/ cm, with a maximum in summer and a minimum in the monsoon season. Alkalinity was high during the summer season followed by a steep fall in the monsoon. Total alkalinity values fluctuated from 102.6 to 215 mg/l, indicating that the water is hard. If the present conditions continue for a long period, Karaivetti Lake may soon become ecologically inactive.

Keywords: Water quality parameter, Karaivetti Lake, fish, Birds population, Avifauna.

INTRODUCTION

Wetlands are very productive ecosystems, which help in the regulation of biological cycles, maintenance of water quality, nutrient movement and support for food chains. In addition, they provide refuge for endangered species of plants and animals and economic benefits such as fish breeding. Wetlands reduce the impact of floods by acting as storage areas. Stored water percolates downward, getting purified in the process, and replenishes the groundwater. But our wetlands are shrinking rapidly because of man's need for space. They are reclaimed for construction purposes to erect industrial colonies, Cement factor and to dump urban wastes, therefore the present concern. The quality of water is of vital concern for mankind since it is clearly linked with human welfare. The main sources of water for the inhabitants of Ariyalur district are groundwater and water reservoirs of the Karaivetti Lake Birds Sanctuary. Reservoirs are important to impound surface water runoff for the requirements of drinking, domestic, agricultural and industrial use. The Kallanai reservoir receives water from the Cauvery River and Karaivetti Bird Sanctuary is visited by attracts a large number various species of wandering water birds. The peak gathering takes place in the month of November when over 2.5 lakhs birds visit this sanctuary.

The Karaivetti Bird Sanctuary attracts 50 species of water birds visit this lake. Important water birds visiting the sanctuary include the high flying Barheaded Goose, long migrants like White Necked Stork, Grey Pelican, and Ibis. Sixteen species of Ducks and 23 Species of Waders have been recorded in the sanctuary. Birds start arriving in November and stay on till May. The other important characteristic of this sanctuary is the presence of water till the month of May as other water sources dry up by the month of March, this sanctuary offers habitat to the water birds till the May end. Population of migratory birds is more in the month of January. Important land birds visiting sanctuary include the Rosy Pastor, Peregrine Falcon, Osprey, Marsh Harrier, Tawny Eagle etc., and nearly 100 species of land birds have been recorded in the sanctuary 50 species of water birds visit these lake migratory birds, water birds and domestic birds of the Karaivetti Lake.

The water from this wetland, besides being a source of potable water for inhabitants of Ariyalur, has economic value such as for fish breeding. Man's activities, including agricultural practices, that are carried out within the catchment area affect biodiversity. The physical and chemical characters of the reservoir water can be used to assess the ecological nature of the reservoir. Several studies have been conducted to understand the physical and chemical properties of lakes, ponds and reservoirs such as the Halai Reservoir, Kolovoi Lake, Kalyani reservoirs, Salim Ali Lake, Dahikhura reservoir, and wetlands in urban Coimbatore in India (Jain et al., (1996); Sreenivasan et al., (1997); Srinivasa Gowd and Kotaiah (2000); Thorat and Masarrat Sultana (2000); Yogesh Shastri and Pendse (2001); Mohanraj et al., (2000). The main focus of the study of Rai and Munshi (1979); Rai and Sharma (1991); Munshi et al., (1993); Dehdrai (1994); Salodia, (1995); Kumar and Singh (1996) and Verma et al., (2001) were related to water bodies/wetlands, which support the culture of carps (food fishes) and are economically important.

In such studies the characteristics of water bodies were taken into consideration with reference to physical, chemical and biological properties. Gupta et al., (2001) have used only chemical characteristics of water bodies of Udaipur in their observations. Srivastava et al., (2003) studied the physicochemical properties of various water bodies in and around Jaipur. His results revealed that the water of Jalmahal Lake is most polluted due to high pH, hardness, alkalinity, free carbon dioxide, zinc content, and a low level of dissolved oxygen. It is a well-established fact that domestic sewage and industrial effluent discharges result in changes of water quality and eutrophication. The other important sources of water pollution include mass bathing, disposal of dead bodies, rural waste matter, agricultural runoff and solid waste disposal. The present study was undertaken to analyze the physical and chemical nature of the important water reservoir for the inhabitants of Karaivetti lake Ariyalur District.

MATERIALS AND METHODS

Study area

The Karaivetti Bird Sanctuary (10^0 58' 01" N, 79^0 11' 07" E) is located in Ariyalur District of Tamil Nadu. The total Area of the Karaivetti Birds Sanctuary is 454 hectare and attracts large a gathering of waterbirds. This freshwater lake is fed by Pullambadi and Kattalal canals. The Birds Sanctuary gets annual rainfall of 2000 mm. Temperature varies from 14o C to 33o C.

The Karaivetti Bird Sanctuary is visited by various species of wandering water birds. The peak gathering takes place in the month of November to March. When over 2.5 lakhs birds visit this sanctuary. It has a catchment area of 21.30 square miles and a gross storage capacity of Reservoir 145 million cubic feet, top of bund level 170.90 feet, Maximum water level (full reservoir) 165.90 feet. Water samples were collected for physico-chemical analysis from One pullambadi inlet area, four inlet area of the karaivetti lake and four outlet area of the karaivetti lake sampling stations at the wetland. Samples were taken once every month from September 2009 to February 2010. Water samples were collected in one liter plastic bottles and collection was usually completed during morning hours between 8:00 A.M. to 10:00 A.M. For each sampling event, pH, temperature and dissolved oxygen were monitored at the sampling sites while EC, TDS, DO, BOD, Hardness, sodium, Potassium, Calcium, Magnesium, Sulphate, Nitrate, Chloride and Phosphate were analyzed in the laboratory in accordance with APHA (1989); Trivedy & Goel (1986) and Maiti (2001).

Study Period

The study was extensively carried out form September 2009 to February 2010.

RESULTS AND DISCUSSION

It is an established fact that maintenance of healthy aquatic ecosystem is dependent on the physicochemical properties of water and biological diversity. Temperature is one of the most important ecological factors, which controls the physiological behavior and distribution of organisms. Minimum and maximum temperatures recorded in our study range from 14 to 33^{o}C respectively (Figure 2). The temperature of lake water varied with seasons. Water temperature was found to be lower than atmospheric temperature. During the winter season water temperature was low due to frequent clouds, high humidity, high current velocity and high water level. Shakar et al., (1993) observed diurnal variation in some abiotic parameters of water at the Gupt-Ganga station of the torrential Neeru Nallah of Bhaderwah (Jammu) and Jain et al., (1996) also observed diurnal variations in temperature in the Halai Reservoir of Vidisha which influence the aquatic life and concentration of dissolved gases like CO2, O2 and chemical solutes.

Higher temperatures were observed during summer due to clear atmosphere, greater solar radiation, and low water level. Swaranlatha and Narsing Rai (1998) made a similar observation in their study of Banjara Lake. Yogesh Shastri and Pendse (2001) also made similar observation of the Dahikhura Reservoirs. One of the most important factors that serve as an index for pollution is pH. In our study, the pH of the Karaivetti Lake water ranged from 6.31 to 8.27 (Figure 2), this may be due to the high buffering capacity of the system. The pH of water was relatively high in the winter months and low in the monsoon and summers. Maximum values reached 8.27 in October and the lowest value of 6.31 occurred in the month of August. The higher values of pH recorded during winter months could be

attributed to increased primary productivity wherein carbonates, sulfate, nitrates and phosphates are converted to hydroxyl ions.

The lake water was always alkaline as pH constantly remained above 7. The earlier studies show that the range of pH of a majority of lakes and reservoirs lies between 6 and 9. This is in accordance with earlier reports by Wetzel (1975) who reported that the value of pH ranges from 8 to 9 units in Indian waters. The lower pH during monsoon is due to high turbidity, and in summers, the high temperature enhances microbial activity, causing excessive production of CO2 and reduced pH. Khan & Khan (1985) and Narayani (1990) also reported similar results at Seikha Jheel in Aligarh and eutrophic wetlands (lower lake, Bhopal) respectively. Ghose and Sharma (1988) also recorded relatively high pH of water in winter months in their study of the Ganga River attributing high pH to increased primary-productivity.

The electrical conductivity values of water samples ranged between 500-700 micromhos/cm (Figure 2), with a maximum in summer and a minimum in the monsoon. Conductivity of water depends upon the concentration of ions and its nutrient status and the variation in dissolved solid content. Dilution of water during the rains causes a decrease in electrical conductance.

The total dissolved solids values of water samples ranged between 294.40 – 348.40 mg/l (Figure 2). The concentration is high during the monsoon, which may be due to addition of solids from the runoff water. Marker (1977) has made the same observation. The amounts of total solids are influenced by the activity of plankton and organic materials. Oxygen is an important parameter of the wetland /reservoir which is essential to the metabolism of all aquatic organisms that possess aerobic respiration. Concentration of dissolved oxygen indicates water quality and its relation to the distribution and abundance of various algal species. In the present study, the dissolved oxygen of water samples ranged from 1.90 to 6.13 mg/l (Figure 2). Presence of dissolved oxygen in water may be due to direct diffusion from air and photosynthetic activity of autotrophs. In the present study a strong correlation was also observed between pH and dissolved oxygen; with the lowering of pH, dissolved oxygen was also lowered. The addition of a variety of biodegradable pollutants from domestic and industrial sources stimulates the growth of microorganisms, which consume the dissolved oxygen. The values further deplete during summers because at high temperature, the oxygen holding capacity of water decreases. Present observations are in agreement with similar ones made by Verghese et al., (1992) at a domestically polluted tropical pond and Yogesh Shastri and Pendse (2001); Shanthi et al., (2002) who studied the Dahikhura Reservoir and Singanallur Lake respectively. Pandey and Soni (1993) had observed high values of free carbon dioxide, alkalinity and pH along with low dissolved oxygen in highly polluted lake water at Naukuchiyatal Lake situated in Kumaon, Himalayas. Alkalinity and pH are the factors responsible for determining the amenability of water to biological treatment (Manivasakam, 1980). Bishop (1973) and Jain et al., (1996) also reported similar findings in their study on Malayan rivers and the Halali Reservoir.

The total hardness of this wetland water was observed to be high (96 mg/l) (Figure 2) during the summer season which may be due to evaporation of water and addition of calcium and magnesium salts. Bagde and Verma (1985) suggested a similar finding about J.N.U. Lake. Khan et al., (1986) studied the hardness in different reservoirs of Bhopal during the winter season and showed that the hardness varied from reservoir to reservoir due to their geological setting. Kannan (1991) has classified water on the basis of hardness values in the following manner: 0-60 mg/l, soft, 61-120 mg/ l, moderately hard, 121-160 mg/l, hard and greater than as 180 mg/l very hard. Using these criteria, the water of the Karaivetti Lake wetland can be included in the moderately hard category. The observed higher values of alkalinity with respect to hardness indicate the presence of basic salts. Sodium and potassium in addition to those of calcium and magnesium. Chloride levels of the wetland water were found to be high (266 mg/l) during the summer period.

The higher concentration of Cl- is considered to be an indicator of higher pollution due to higher organic waste of animal origin. Munawar (1970) observed a direct correlation between Cl concentration and pollution level in fresh

water ponds of Hyderabad. Govindan and Sundaresan (1979); Jana (1973) observed that concentration of higher Cl- in the summer period could be also due to sewage mixing and increased temperature and evaporation by water. In Karaivetti Lake, reeds and other aquatic vegetation are plentiful in the shallow region and they are an ideal feeding ground for birds. Human interference, which was restricted to bathing and washing of clothes in the lake previously, now includes recreation for visitors, especially tourists. Man's activities and agricultural practices in the drier areas of the wetland have resulted in constant disturbances all around the lake.

Water Birds of Karaivetty Sanctuary

Forty-five species of water birds were recorded in the Karaivetti Lake during the study period. Among them one Species belongs to podicipediformes, three species to Pelecaniformes, twele species to Ciconiiformes, seven species to Anseriformes, one species to Gruiformes, twele species to charadriiformes and three species to Ciconiiforms. These birds were ecologically classified into five group namely, **Divers** (Little Grebe, *Tachybaptus ruficollis*,Little Cormorant, *Phalacrocorax niger*, Great Cormorant, Phalacorcrax carbo, Common coot, *fulica atra* and Darter *Anhinga rufa*), **Swimming birds** (Common Teal, *Anas creca,*cotton teal *Nettapus coromandelianus,*Pintail *Anas acuta*, Garganey *Anas querquedula* Garganey *Anas querquedula,* Sholverller *Anas clypeata*, Lesser whistling Teal *Dendrocygna javanica*, Spotbill Duck *Anas poecilorhyncha*, and Grey Pelican *pelecanus philippensis*)

Small Waders (Pheasant-tailed, Jacania Hydrophasianus chirurgus, Red-wattled Lapwing *vanellus indicus*, Yellow-wattled Lapwing *vanellus malabaricus*, Golden Plover *pluvialis dominica*, Green Sandpiper *Tringa ochriopus*, Greenshank *Tringa nebularia*,Little Ringer plover *charadrius dubius,* Marsh sandpiper *Tringa stagnalitis,* Redshank *Tringa tetanus,* Common Sandipiper *Tringa hypoleucos* and Black Winged stilt *Himanotopus himanotopus).* Large Egret *Egretta alba,* Cattle Egret *Bubulcus ibis,* Grey Heron *Ardea cinerea,* Purple Heron *Ardea purpurea,* Night Heron *Nycticorax nyclicorax,* Pond Heron *Ardeola grayii,* White ibis *Threskiornis aethiopica,* Glossy Ibis *Plegadis falcinellus,* Openbill Stork *Anastomus oscitans* and Spoonbill *Platalea Leucorfia)* and Aerial foragera *(*Little tern Sterna *albiforns,* whiskered Tern *Chilidonian hybridus,* Small blue kingfisher *Alcedo atthis,* Pied Kingfisher *Ceryle rudis* and White- breasted kingfisher *Halcyon smrensis.).* Water birds recorded in the karaivetti birds santucary (Table.1)

During the three months study (Jan to Mar), a total of 853 birds were recorded from the study area. Among them, Jan461.6, Feb 393.1 and 287.1 were summer migrants (Fig. 2)(Table. 3).At 2008, a total of 334 birds were observed among which 134.1, 105.5 and 94.4.At 2009, a total of 310.1 birds were observed among which 151.6, 97.2 and 61.3were observed. At 2010, a total of 497.7 birds were observed among which 175.9, 190.4 and 131.4 were observed. The Composition of bird population at three sites is presented in Figs. 3, 4 and 5 and Table 4, 5 and 6.

Threats and Conservation Issues of Karavetti Bird Sanctuary

Five villages with 23,500 human populations surrounded the lake. The socio economic surveys revealed that the lake is playing a vital role in the livelihood of the human population of the villages. Agriculture is the main occupation of the people of these village and they greatly depend on the lake for irrigation, cattle washing etc. Thus there exists a conflict between wildlife and human in around this lake.

Weed Invasion

The *Ipomoea* and *Icornia* (weed) invasion was very high in the lake. The Ipomoea and I former invasion charged the water quality and reduced the primary production and nutrient cycle in the lake, southern India. So, it should be removed totally from the Karaivetty bird sanctuary.

Pollution

Pollution from the agricultural runoff from the nearby village and agricultural practices is another major threat to the faunal diversity in the lake as approximately 2000 tons of fertilizers and 2500 liters of pesticides are used annually for agricultural purposes in the catchments area of the lake.Such environmental pollutions could cause severe damages to the water quality and thereby to the wetland's biodiversity. So the Agriculture Department should take necessary steps of reduce the use of pesticides and educate the farmers on the importance of organic farming. Government and NGOs must undertake awareness campaigns about the proper methods of solid waste disposal.

CONCLUSION

Aquatic birds are important components of wetland ecosystem as these blinds are at relatively higher level in the food chain and represent a verity of predatory niches. According to the activities the wetland birds are grouped into Diving birds, Swimming birds, Small warders, large waders and Aerial waders.The present study was conducted in Karaivetty birds Sanctuary, Ariyalur district, Tamil Nadu one of the important sites famous for its, wintering congregation of water fowl. The censuses were conducted in the month of January 2011.

The age-old Indian philosophy appears to be undergoing changes. Population growth and fast methods of production have given rise to developmental programs. They generally undermine the importance of lakes, wetlands and areas that maintain vegetation and support a vast variety of life forms. Wetlands are shrinking fast because of man's greed for space and profit. They are reclaimed for construction purposes to erect industrial colonies and to dump urban wastes. However, this process is fortunately not prevalent in Rajasthan. But the damage done by geological exploration and development such as stone mining creates silting etc. to the wetland, which is irreversible. The result of this study necessitates that some drastic regulations be made and warrants remedial measures to save this wetland.

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Fig.1. Location of the Karauvetty Lake, Ariyalur District.

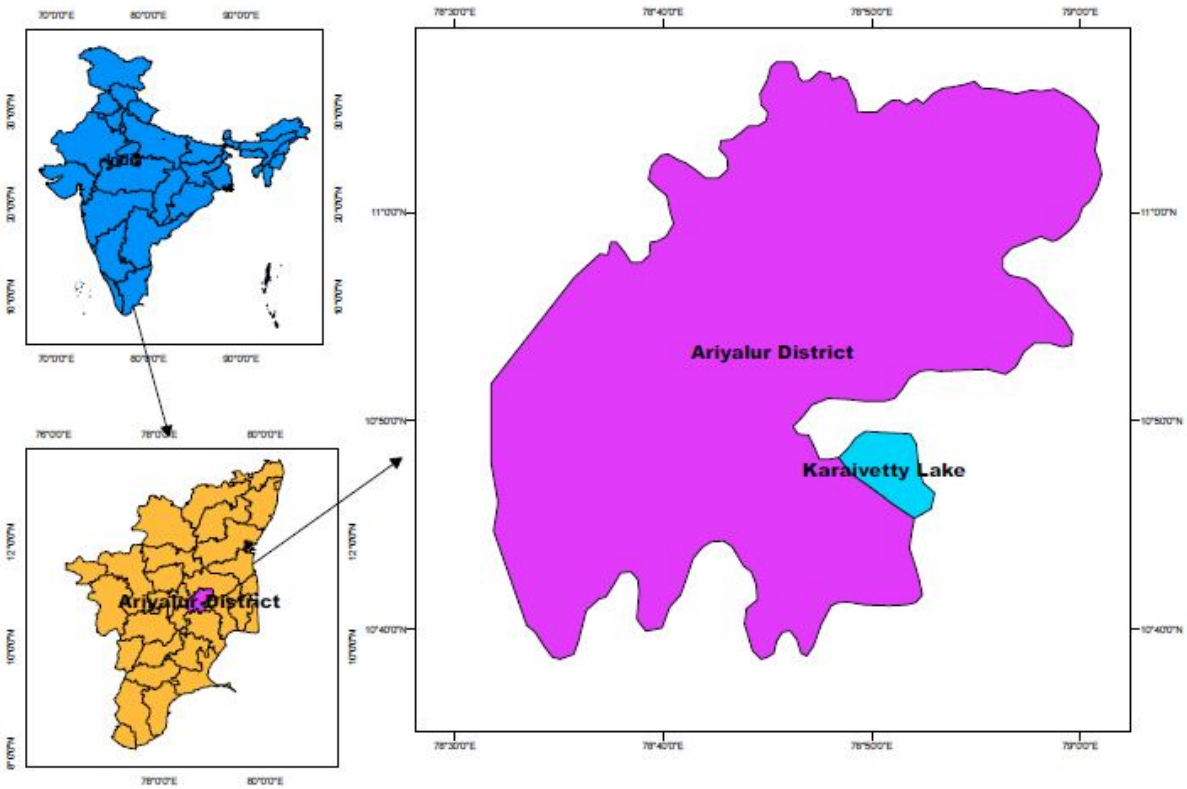
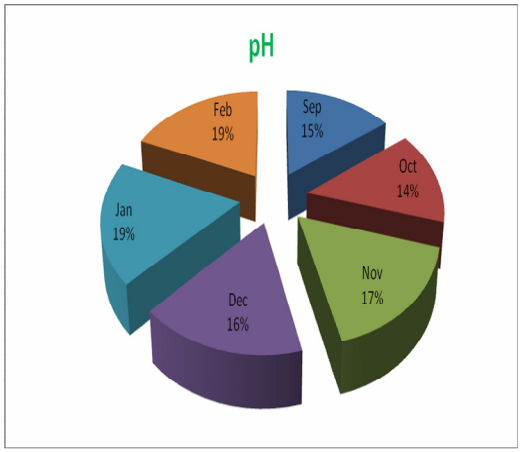
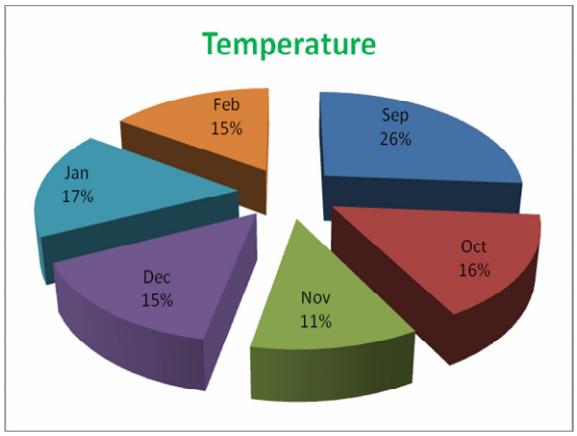
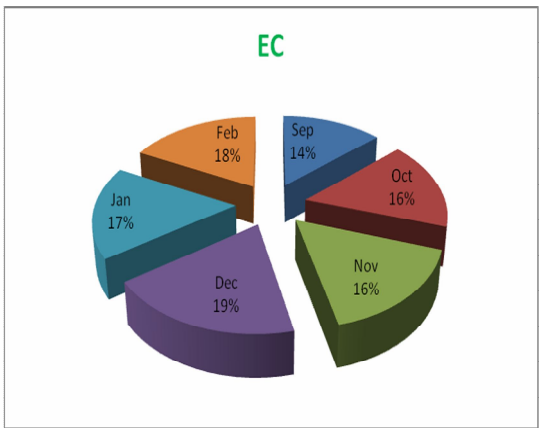
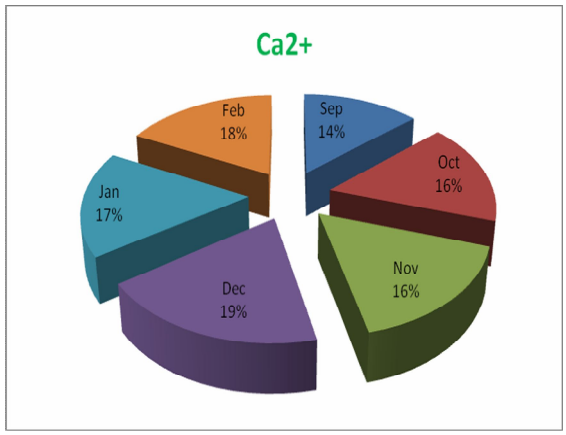


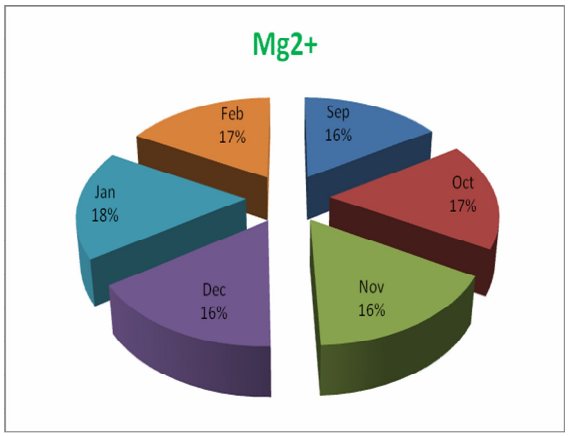
Fig.2 Karaivetti Lake Water Quality Analysis Results (Sep 2010 – Feb 2011)

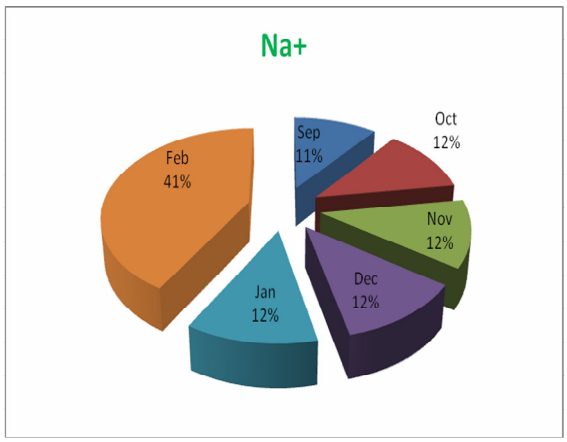


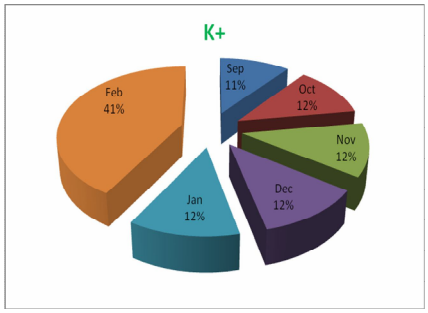








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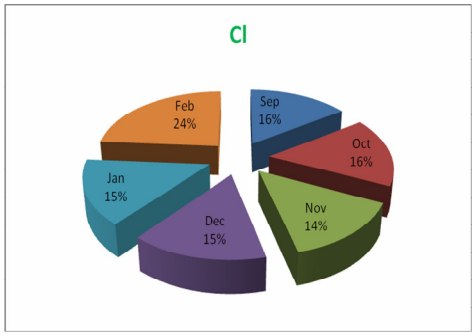
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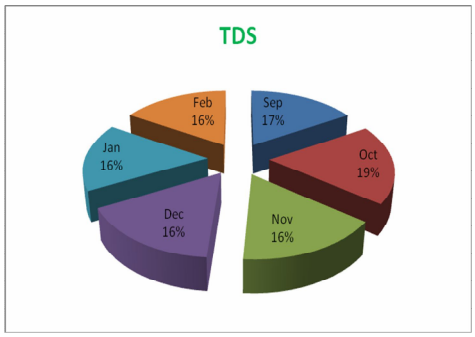
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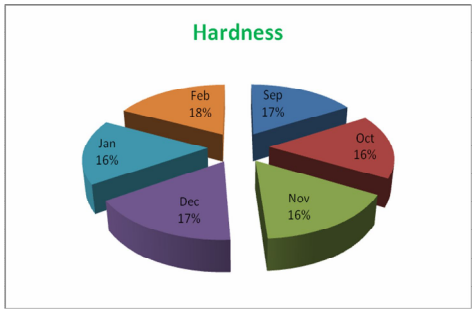
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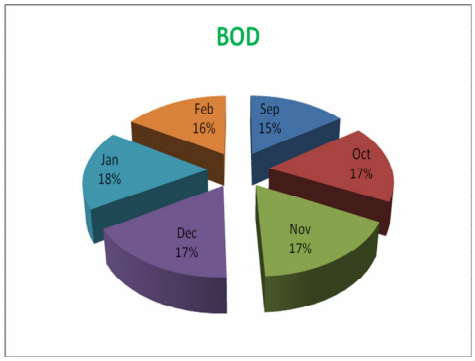
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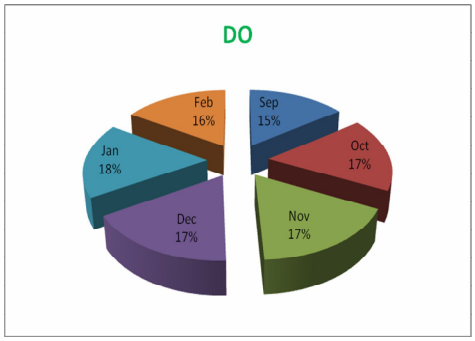
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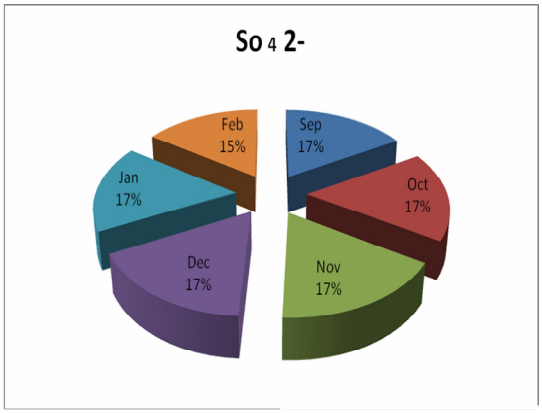
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RESEARCH ARTICLE

Comparative Study on the Removal of Congo Red by Adsorption on Various Low Cost Adsorbents

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ABSTRACT

Studies on the removal of Congo Red (CR) by adsorption on various adsorbents such as *Ocimum sanctum* Carbon (OSC), *Emblica officinalis* Bark Carbon (EOBC), have been made and the results have been compared with that of commercial activated Carbon (CAC). Effect of various experimental parameters has been investigated using batch adsorption technique at room temperature (30±1 ^{0}C). The percentage removal of CR increases with decrease in the initial concentration of CR, initial pH and particle size of adsorbent and increases with increase in the contact time and dose of adsorbent. Adsorption data were modeled with the Freundlich and Langmuir adsorption isotherms and various first order kinetic equations at 30±1 ^{0}C. The kinetic of adsorption is found to be first order with intra particle diffusion as one of the rate determining steps. The mechanism of adsorption for CR on to various carbons were investigated by using the experimental results and confirmed by FI-IR and SEM images. The adsorbent materials OSC, EOBC could be employed as low cost adsorbents as alternative materials to CAC for the removal of CR.

Key words: Congo Red, OSC, EOBC, Freundlich and Langmuir isotherms, Kinetics of adsorption, Intra particle diffusion, Wastewater treatment.

INTRODUCTION

Wastewater released from dye industries into nearby land (or) rivers without any treatment, it will affect the nature bodies. Which is largely affect the ground water and pollute the environment. Colour is the first contaminant to be recognized, since it is visible to human eye. So, effluent treatment for removal of colour is necessary to protect the environment and the aquatic life. Removal of dyes by conventional chemical and biological methods is not effective. Adsorption is one of the most effective methods and followed for the removal of dyes. Activated carbons (ACs) are the preferred adsorbent widely employed for the removal of dyes from effluent due to its effectiveness and versatility. Despite of its prolific use in water and wastewater industries CAC remains an expensive material.

The adsorption process provides an alternative tool especially, if the adsorbent is an inexpensive and readily available. By far, activated carbon has been the most favoured material for adsorption of various materials like herbicides, toxic metal ions, dyes, [1]. Many investigators have studied the feasibility of using inexpensive alternative adsorbent materials such as nut shell, fly ash, fruit stones and scrap tyres [2] and pearl millet husk, date pits, saw dust coir pith, buffing dust of leather industry, crude oil residue tropical grass, olive stone and almard shells, pine bark, wool waste, coconut shell as alternative to CAC [3]. Various other non-conventional adsorbents like Fuller's and Fired clay, Silica [4] biogas residual slurry[5], Fe^{3+}/Cr^{3+} hydroxide sludge [6], China clay [7], Peat moss and rice hulls [8], coconut hust [9] and fly ash [10],[11] have also been reported as efficient adsorbent in removing colour.

Attempts have been made to prepare activated carbon from agricultural and industrial wastes. Preparation of ACs from a wide range of agro wastes for water purification has recently been reported by Pollard et al [2]. ACS prepared from agricultural wastes and plant materials are used as adsorbents [2], [12], [13] and [14].In order to make the dyeing wastewater treatment economical, it is imperative to go for low cost adsorbents. The aim of this paper is to assess the ability of those carbons (OSC, EOBC) which are prepared from plants material to adsorb Congo red from aqueous solution and to study the kinetics of removal of CR. The objectives of this paper are to study the effort of various process parameters on the extent of removal of CR, to optimize the process parameters and to apply various adsorption isotherms and first order kinetic equations to the adsorption data.

MATERIALS AND METHODS

Materials

Commercial Activated Carbon (CAC) was procured from E Merck (India). The dye CR, supplied by BDH (India) was used as received and the structure is shown in figure 1. Double Distilled (DD) water was used for preparing all the solutions and reagents. Thermostatic incubator shaker (Neolab, India) was used to maintain the temp (30±1 ^{0}C).Raw materials for the preparation of indigenously prepared activated Carbons (IP ACS), which are *Ocimum sanctum*, *Embolica officinalis bark* were collected in the form of coarse powder wastes dust. This is obtained after extraction of the herbal contents at Aravind Herbal production Pvt. Ltd., Rajapalayam, Virudhunagar District, Tamil Nadu, India.

Preparation and activation of ACs

These raw materials were dried and carbonized with concentrated sulphuric acid in the weight ratio of (1:1) (w/v). The carbonization and activation has completed by heating for 12 hrs in a furnace at 400 ^{0}C. The resulting carbon washed with distilled water until a constant pH of the slurry reached. Then the carbon has dried for four hours at 120 ^{0}C in a hot air oven. The dried material was ground well to a fine powder and sieved into discrete particle size

(Jeyant Sieve, India) and stored. The dye (CR), supplied by BDH (India) was used as an adsorbate. Double Distilled (DD) water was used for preparing all the solutions and reagents. Thermostatic incubator shaker (Neolab. India) was used to maintain the temp (30±1 ^{0}C).

Instrumental analysis
Calibration plot

A stock solution of CR (1000 mg L^{-1}) was prepared and suitably diluted accordingly to the various required initial concentrations. Adsorption experiments were carried out at room temperature (30 ±1^{0}C) under batch mode [17]. The concentrations of the CR solution was analyzed by measuring its absorbance at λ_{max} = 497 nm (figure 2) with the help of UV–Visible Spectrophotometer (ELICO Semi Micro Spectrophotometer, (Model, no: 207) India, and there interpolated into the standard curves as shown in figure 3.

Adsorption experimental procedure

Exactly 50 ml of CR solution of known initial concentration (C_i) was shaken at constant agitation speed (200 rpm) with required dose of adsorbent of a fixed particle size (90 micron) for a specific period of content time (Table 1). The pH of the dye solution (6.6) was adjusted by adding either 1 M HCl (or) 1 M NaOH solution. Initial pH values of dye solutions were noted with digital pen pH meter (Hanna instruments, Portugal). After equilibration, the final concentration (C_f) of CR was measured by using a UV – Visible Spectrophotometer (ELICO – Semi micro spectrophotometer, Model No. 207 India). The values of percentage removal and the amount of dye adsorbed were calculated using following relationships.

$$\text{Percentage removal (\%)} = C_i - C_f \,/\, C_i \times 100 \quad \ldots\ldots 1$$

$$\text{Amount adsorbed } (q_e) = C_i - C_f \,/\, m \quad \ldots\ldots 2$$

Where,

C_i = initial concentration (ppm)
C_f = final concentration (ppm)
m = mass of adsorbent (gL^{-1})

Control experiments were carried out and the average values of duplicate runs were obtained and analyzed (Error: ± 1 – 2% for percentage removal and ± 0.005 – 0.01 mg g^{-1} for amount adsorbent).

RESULTS AND DISCUSSION

Effect of Initial Concentration

The adsorption experiments were carried out at different experimental conditions (Table 1) and the result obtained are discussed as follows: The effect of initial concentration on the extent of removal of CR (in terms of percentage removal and amount adsorbed) on low cost carbons like OSC, EOBC are shown in figure 3 and the relevant data are given in Table 2. The percentage removal was found to decrease exponentially, while the amount of dye adsorbed increased exponentially with the increase in initial concentration of CR.

This indicates a decrease in adsorption, which is attributed due to the lack of available active sites required for the high initial concentration of CR. Similar results have been reported in literature on the extent of removal of dyes [19], [14],[16] and [12],[18] Metal ions [13],[15] and Carboxylic acid [20],[21]

FT – IR Spectroscopic Studies

FT- IR serves as direct mean for the identification of the organic function groups on the surface. An examination of the adsorbent surface before and after adsorption possibly provides information regarding the surface groups that might have participated in the adsorption and also indicated the surface sites on which adsorption has taken place.

According to the spectrum the band at 3231 cm^{-1} is –OH stretching of activated carbon. The peak at 3198 cm^{-1} indicated the asymmetric vibration of $–CH_2$ and symmetric vibration if $–CH_2$ respectively. The presence of a band around 2924cm^{-1} denotes the presence of C=O stretching, The overlapping bands in the region 1600- 1500 cm^{-1} may be related to –C=C vibration and around 1620 cm^{-1} us attributed to the presence of highly conjugated carbon group, The band at 1112-1022 cm^{-1} indicated the presence of phenolic group. Other broad absorption around at 871 cm^{-1} is due to –C-O stretching in acidic group.

The FT-IR Spectrum of after adsorption in CAC shows that some peaks were shifted or disappeared and that new peak were also detected. These changes observed in the spectrum indicated the possible involvement of those functional groups on the surface of the adsorbent in adsorption process.

Surface morphological analysis

Examination of the SEM micrographs (Figures 6,7) before and after absorption of the clean activated carbon particles showed smooth areas with long ridges and rough areas with microspores and more number of edges. An electron microscope study reveals highly porous, small cavities, pores and more rough surfaces on the carbon sample indicated the presence interconnected porous network. Tubular pores and cavities will increase the surface area of the adsorbent clearly shows the morphology of highly porous activated carbon sample. Most of the particles are having very fine pores of < 1μm size in the cavity walls.

Adsorption Isotherms

The adsorption data were analysed with the help of the following linearised forms of Freundlich and Langmuir isotherms (Adamson, 1960)

Freundlich isotherm : $\log q_e = \log K + 1/n \log C_e$ 3

Langmuir isotherm : $C_e/q_e = 1/Q_0 b + C_e/Q_0$ 4

Where,

K	-	adsorption capacity
(1/n)	-	order / intensity of adsorption
q_e	-	amount of CR adsorbed per unit mass of adsorbent (mg g^{-1})
C_e	-	equilibrium concentration of dye (ppm)
Q_0	-	monolayer (maximum) adsorption capacity (mg g^{-1})
b	-	Langumuir constant related to energy of adsorption (mg^{-1})

The values of Freundlich and Langmuir parameters have been obtained, respectively, from the linear correlation between the value of (i) log q_e and log C_e and (ii) (C_e / q_e) and C_e (Table – 3). They are found to be linear (for the evidence the figure 9), indicating the applicability of these adsorption isotherms for removal of dye by these adsorbents are the monolayer formation.

The monolayer adsorption capacities (Q_0) of the adsorbents are found to be of the order given below.

OSC < EOB C < CAC

Further, the essential characteristics of the Langmuir isotherms can be described by a separation factor R_L. The values of separation factor, R_L, indicate the nature of the adsorption process as given below.

RL values	Nature of adsorption Process
$R_L > 1$	Unfavourable
$R_L = 1$	Linear
$0 < R_L > 1$	Favourable
$R_L = 0$	Irreversible

In the present study, the values of R_L (Table 3) are observed to be fraction i.e., in the range of zero to one (0.028 – 0.064), which indicate that the adsorption process is favourable for all these low cost adsorbents.

Effect of contact time

The effect of contact time on the amount of dye adsorbed was observed at constant optimum initial concentration of dye. Adsorption experiments were carried out at different contact time (5, 10, 15 . . . 50 min.). The extent of removal of CR dye by these adsorbents is found to increase and reach a maximum value with increase in contact time. The relative increase in the extent of removal of dye after 40 min., of contact time is not significant and hence it is fixed as the optimum contact time. In batch type adsorption systems, monolayer of adsorbate (dye) species is formed on the further of adsorbent and the rate of removal of adsorbate species from aqueous solution in controlled primarily by the rate of transport of the adsorbate species from the exterior / outer sites into the interior sites of the adsorbent (CAC / IPACS) particles. Similar results have been reported in literature for the removal of dyes [11], [16],and[18] metal ions [13],[15] and carboxylic acids [20] and [21].

Kinetics of Adsorption

The kinetics and dynamics of adsorption of CR on various adsorbents (CAC / IPACS) have been studies by applying the following kinetic equations.

Natarajan and Khalaf equation: $\log (C_i/C_t) = (K_{ad}/2.303)\, t$ …….5

Lagergren equation : $\log (q_e - q_t) = \log q_e - (K_{ad}/2.303)\, t$ 6

Battacharya and Venkobachar equation: $\log [1-U(T)] = -(K_{ad}/2.303)\, t$ ... 7

Where,

C_i and C_t- concentration of CR at time zero and time (t), respectively (mg l^{-1})

q_e and q_t-amount of CR adsorbed at equilibrium and time (t), respectively (mg g^{-1})

$U(T) = [(C_i - C_t) / (C_i - C_e)]$ 8

C_e - equilibrium CR concentration (mg l^{-1})

K_{ad} - first order adsorption rate constant (min.$^{-1}$)

The values of $\log (C_i/C_t)$, $\log (q_e - q_t)$ and $\log [1-U(T)]$ were linearly correlated with time (t). The values of first order rate constant and correlation coefficient (r-values) are given in table: 4 and the graphs are given. All the linear correlations were found to be close statistically significant (as evidence by r – values to unity) indicating the applicability of these kinetic equations and the first order nature of the adsorption process of CR on these low cost adsorbents.

Intra particle diffusion study

The possibility of intra particle (Pore) diffusion process was explored by using the Weber and Morris intra particle diffusion model [23] and [24].

$$q_t = K_p t^{½} + C \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad 9$$

Where,

q_t - amount of CR adsorbed at time, t (mg g^{-1})
C - intercept
K_p - intra particle diffusion rate constant (mg g^{-1} $min^{-1/2}$)

The values of qt were found to be linearly correlated with the values of $t^{½}$ the K_p values were calculated by using correlation analysis (Table - 4). The applicability of this model indicates the presence of intra – particle diffusion process [25]. The intra – particle diffusion plots are given in figures. The values intercept (Table 4) given an idea about the boundary larger thickness that is the large the intercept, the greater is the boundary layer effect [12]and[24]. The correlations of the values of log (% removal) with that of log (time) also resulted in linear relationships (as evidenced by r values close to unity). These results indicate the presence of intra – particle diffusion process in adsorption of Congo Red. The divergence in the value of slope indicates the presence of intra particle diffusion process as one of the rate limiting steps, besides many other processes controlling the rate of adsorption, all of which may be operating simultaneously [23],[12].

Effect of dose of adsorbent

The effect of dose of adsorbent (CAC/IPACS) on the amount of dye adsorbed was studied. The equilibrium value of amount adsorbed (q_e) decreases with increase in dose, the percentage removal of dye was found to increase exponentially with the increase in dose of adsorbent. This may be due to the increase in availability of surface active site resulting from the increased does of adsorbent and conglomeration of the adsorbent especially at higher dose. The relative increase in the extent of removal of CR in found to be insignificant after a dose of 2 gL^{-1} for CAC and 4 gL^{-1} for two IPACS. These are fixed as the optimum dose of adsorbents. The percentage removal of CR graph is shown in the figure 13.

Effect of Initial pH

The effect of initial pH of the dye solution on the amount of CR adsorbed was studied by varying the initial pH, under constant conditions of other process parameters. The pH value changes slightly after adsorption and a decrease in pH value is noted (pH = pH final – pH initial). The optimum pH value is fixed 6.6. The decrease and increase of pH, decreases the amount of CR adsorbed. This is depending upon the nature of surface functional group of the adsorbent and nature of the dose. The percentage removal graph is given in the figure 14. The change in initial pH values of dyes solution significantly affect the adsorption characteristic of acidic dye indicating that removal of CR in enhanced by acidic solution.

Effect of Particle size of IPACS

The effect of particle size on the amount of Congo Red dye adsorbed was studied by varying only the particle size of IPACS as, 45, 90 …….. 250 microns (figure15), but CAC was hot used since its particle size is uniform and constant at 90 micron. The amount of CR adsorbed increases with the decrease in particle size of the adsorbent. This is due to the increase in available surface area with the decrease in particle size. There exists a linear relationship between the amount of dye adsorbed and particle size, as evidenced by the r – value close to unity. Similar observations have been reported for the adsorption of dyes [12], [14], [18] and [24].

Relative Adsorption Capacity

The values of relative adsorption capacity of various IPACS compared to that of CAC are calculated from the Q_0 values, obtained from Langmuir isotherm, which are given in the table 4. The increasing order to relative adsorption capacity of IPACS compared to that of CAC is OSC < EOBC.

CONCLUSION

Congo red dye is found to adsorb strongly on the surface of carbons (CAC / IPACS). The equilibrium adsorption is practically achieved in 30 min. The percentage removal of CR increases with decrease with initial concentration of the dye (CR), initial pH and particle size of adsorbent, and increases with increase in the contact time and dose of adsorbent. Adsorption data were modeled with the Freundlich and Langmuir adsorption isotherms and various first order Kinetic equations at 30±1^{0}C. The results suggest that pore diffusion ie. Intra particle diffusion is more important. Adsorption behavior is described by a monolayer Langmuir type isotherm. The adsorption process is found to be first order with intra particle diffusion, as one of the rate determining steps. The present study concludes that OSC and EOBC could be employed as low cost adsorbents as alternative to CAC for the removal of colour / dyes from water and wastewater in general and for the removal of Congo Red in particular.

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Table 1. Experimental conditions of adsorption experiments for the removal of CR by various adsorbents at 30 ^{0}C.

Variation	Adsorbents	Initial concentration (ppm)	Contact time (min)	Dose of ACs (g/l)	Initial pH	Particle size (µ)
Initial concentration	CAC	10 – 100	30	2	6.6	90
	OSC	4 – 40	30	4	6.6	90
	EOBC	5 – 50	30	4	6.6	90
Contact time	CAC	50	30	2	6.6	90
	OSC	30	30	4	6.6	90
	EOBC	25	30	4	6.6	90
Dose of ACS	CAC	50	30	1 - 2	6.6	90
	OSC	30	30	3.5 - 4.4	6.6	90
	EOBC	25	30	3.5 - 4.4	6.6	90
Initial pH	CAC	50	30	2	2-11	90
	OSC	30	30	4	2-11	90
	EOBC	25	30	4	2-11	90
Particle size	CAC	50	30	2	6.6	45-250
	OSC	30	30	4	6.6	45-250
	EOBC	25	30	4	6.6	45-250

Table 2. Effect of process parameters on the extent of removal of CR and amount adsorbed by various adsorbent at 30 ^{0}C.

Variation	Para meters*	CAC	OSC	EOBC
Initial concentration	% R	94.67-88.88	96.00-91.00	98.00-89.00
	q	21.10-40.00	26.95-35.25	24.95-31.75
Contact time	% R	80.00-86.80	86.92-97.10	90.95-97.80
	q	20.00-21.70	28.25-31.35	2.75-28.87
Dose (gl^{-1})	% R	71.60-93.20	71.85-95.69	78.28-95.67
	q	17.90-23.30	23.35-31.10	22.95-32.70
Initial pH	%R	99.70-92.80	98.00-84.22	96.20-90.78
	q	25.00 -23.20	44.65-37.90	35.70-23.75
Particle size (µ)	%R	-	92.00-99.60	90.97-97.82
	q	-	21.60-28.70	24.28-30.27

Percentage of removal (%R) and amount adsorbed (q in mg g^{-1})

Table 3. Freundlich and Langmuir parameters of adsorption isotherms for the removal of CR by various adsorbents at 30 ^{0}C

Model	Parameters	CAC	OSC	EOBC
Freundlich Isotherm	Slope (1/n)	0.498	0.422	0.472
	Intercept (log K)	0.751	0.689	0.734
	Correlation Coefficient (r)	0.996	0.943	0.993
Langmuir Isotherm	Slope ($1/Q_0$)	0.042	0.032	0.037
	Intercept ($1/Q_0b$)	0.285	0.264	0.276
	Correlation coefficient (r)	0.989	0.938	0.962
	Q_o (mg/g)	37.864	21.789	24.997
	b (g/L)	3.998	2.0521	3.421
	R_L	0.054	0.014	0.028

Table 4. Kinetics and dynamics of adsorption of CR by adsorption on various adsorbents

Parameters	Adsorbents		
	CAC	**OSC**	**EOBC**
Natarajan & Khalaf equation			
Correlation Coefficient (r)	0.991	0.934	0.904
10^2K (min^{-1})	4.108	2.815	2.981
Lagergren equation			
Correlation Coefficient (r)	0.975	0.947	0.959
10^2K (min^{-1})	5.213	47.774	27.521
Bhattacharya and Venkobachar equation			
Correlation Coefficient (r)	0.972	0.943	0.975
10^2 K (min^{-1})	4.945	53.714	34.301
Intra Particle diffusion Model			
K_p	0.943	2.613	2.617
Correlation Coefficient (r)	0.967	0.940	0.976
Intercept	86.341	52.218	54.117
Log (% removal) Vs log (time)			
Slope	0.042	0.205	0.209
Intercept	1.888	1.586	1.483
Correlation Coefficient (r)	0.965	0.954	0.927

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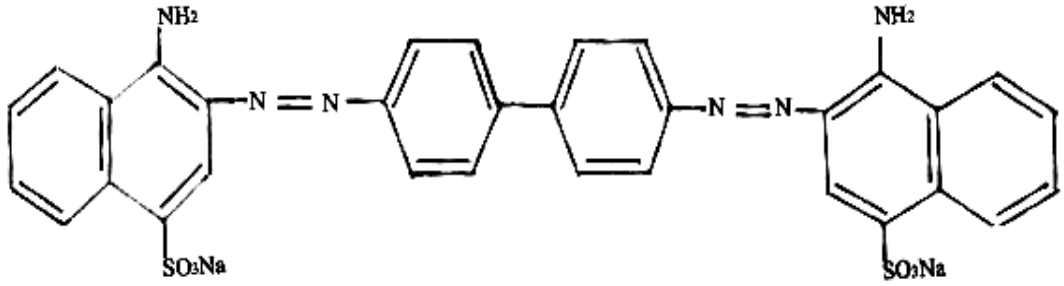

λ_{max} = 497 nm

Figure 1. Structure of Congo red dye

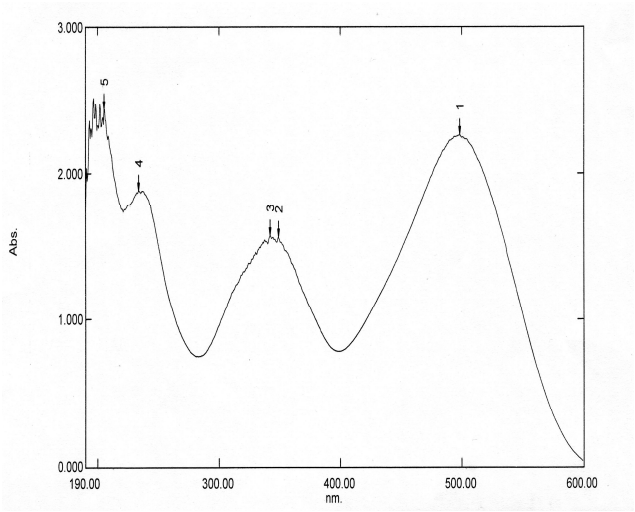

Figure 2 - UV- Spectrum of Congo red dye

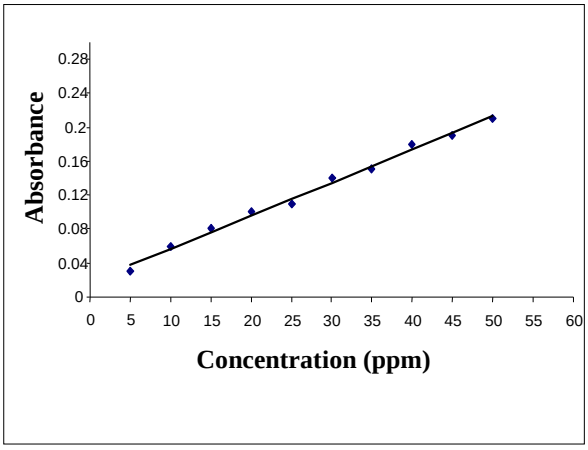

Figure 3. Calibration plot for Congo red dye

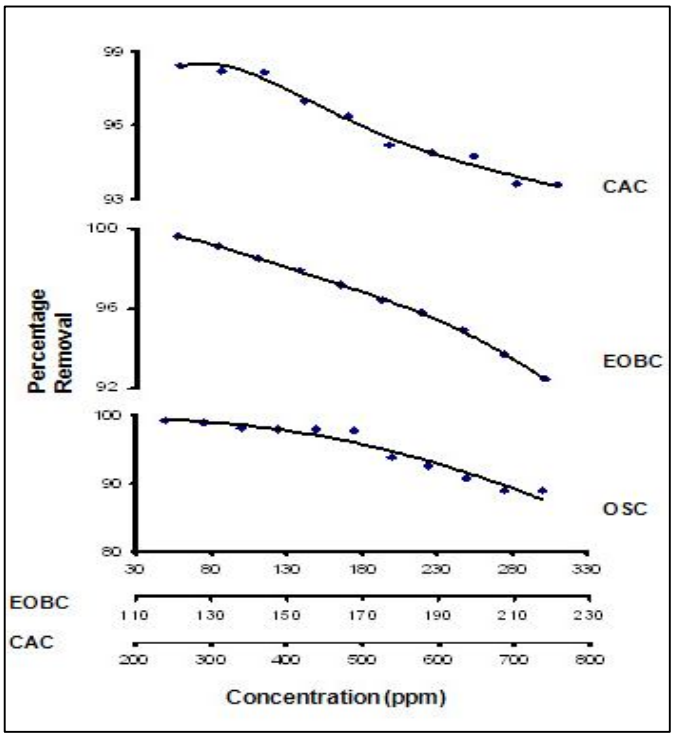

Figure 4. Effect of initial concentration on the extent removal of Congo red dye

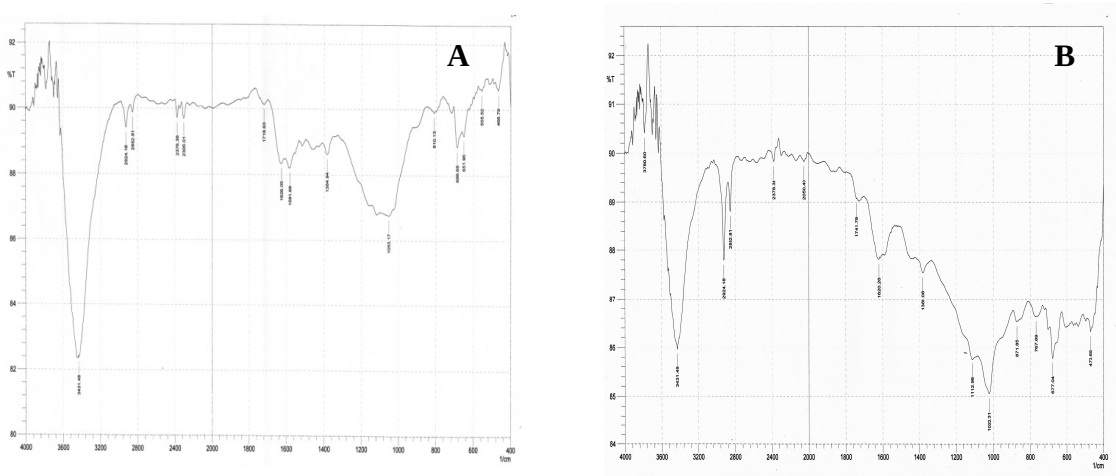

Figure 5. FT-IR spectra of Congo Red before and after adsorption on OSC

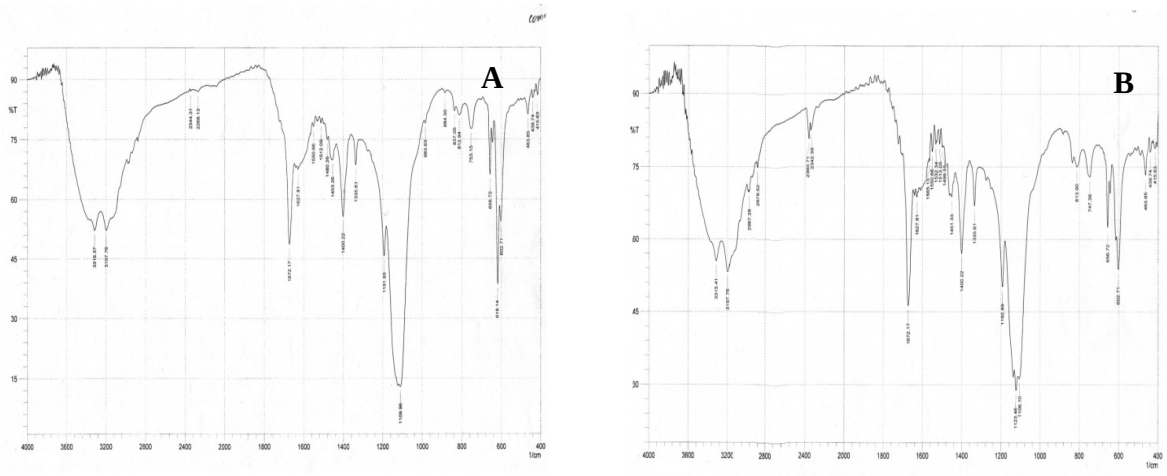

Figure 6. FT-IR spectra of Congo Red before and after adsorption on EOBC

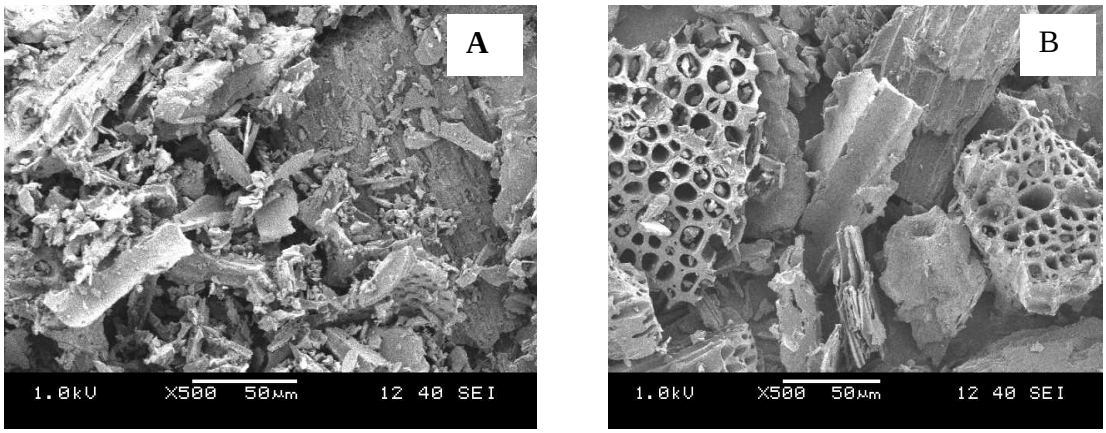

Figure 7. SEM images of OSC before (A) and after (B) adsorption of CR

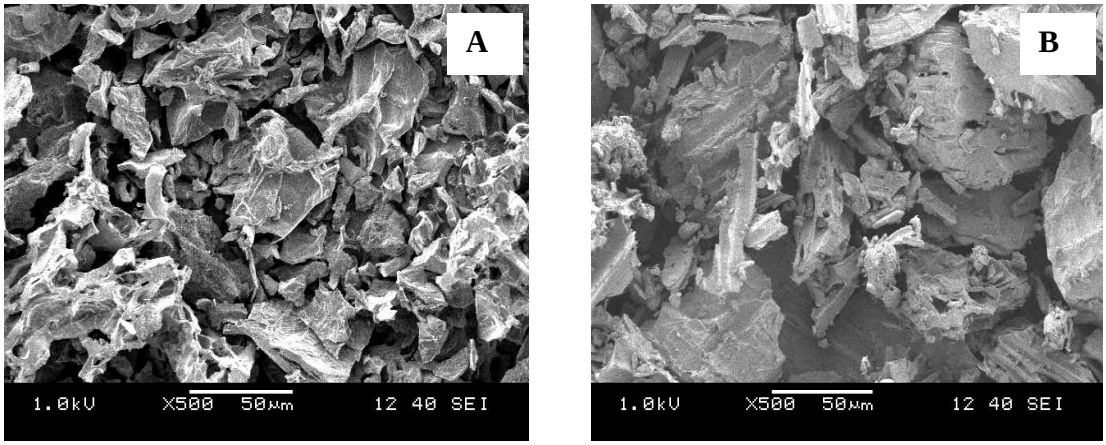

Figure 8. SEM images of EOBC before (A) and after (B) adsorption of CR

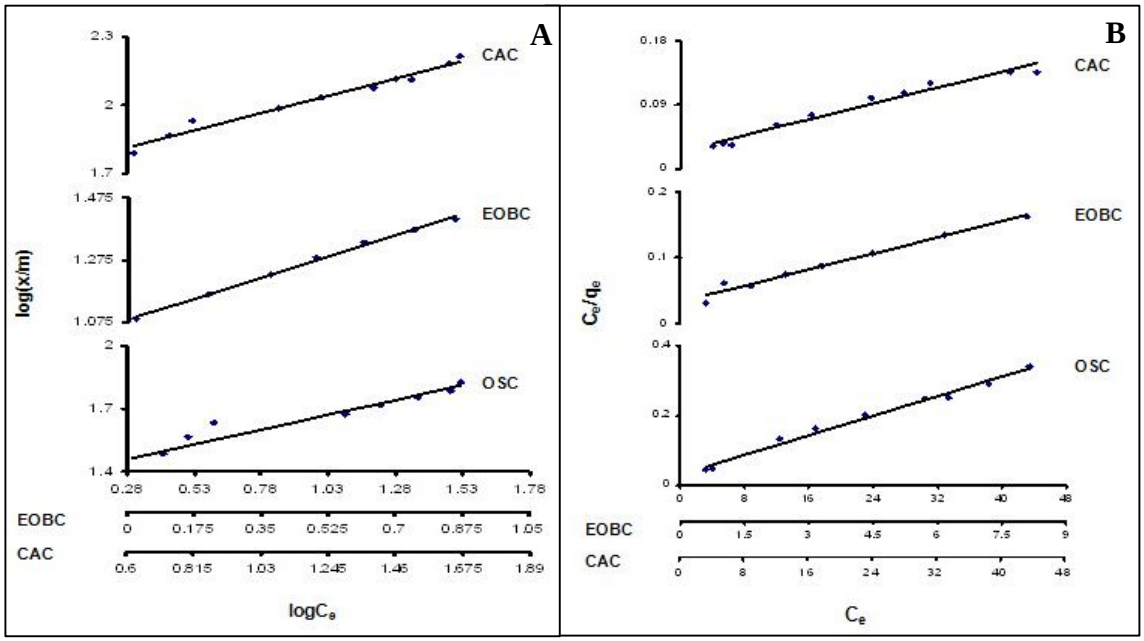

Figure 9. Freundlich (A) and Langmuir (B) adsorption isotherms for the removal of CR various carbons

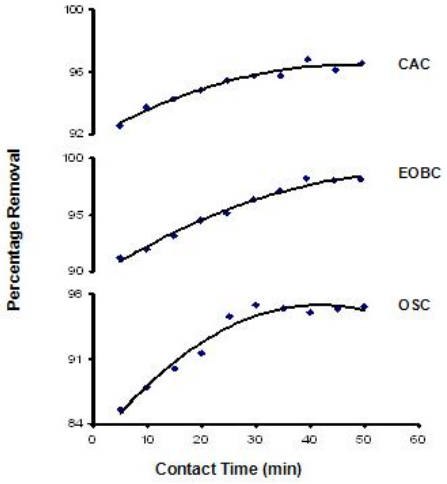

Figure10. Effect of contact time on the extent removal of CR

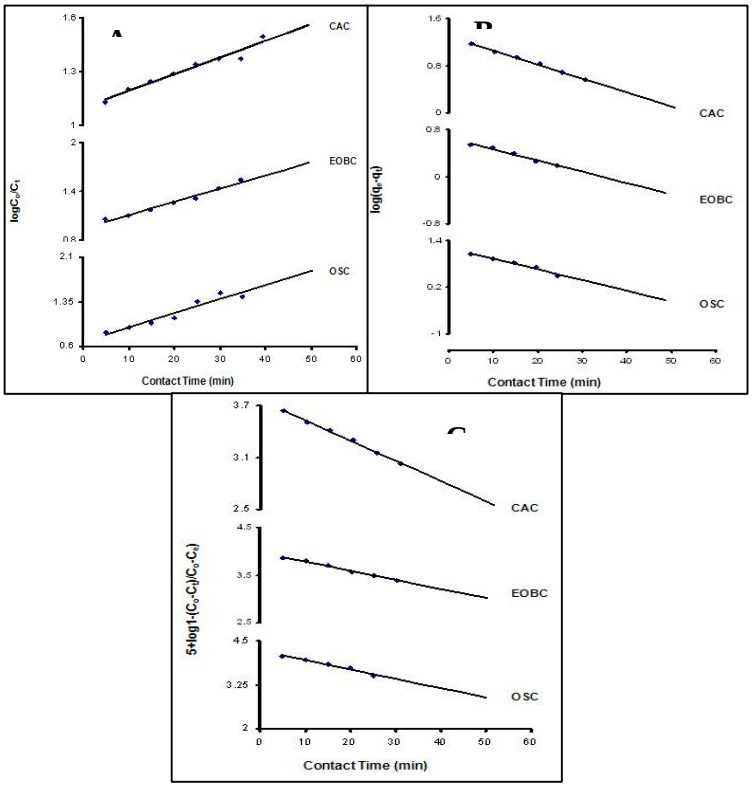

Figure 11. A. Natarajan and Khalaf B. Lagergren; C. Bhattacharya and Vengobachar Plots

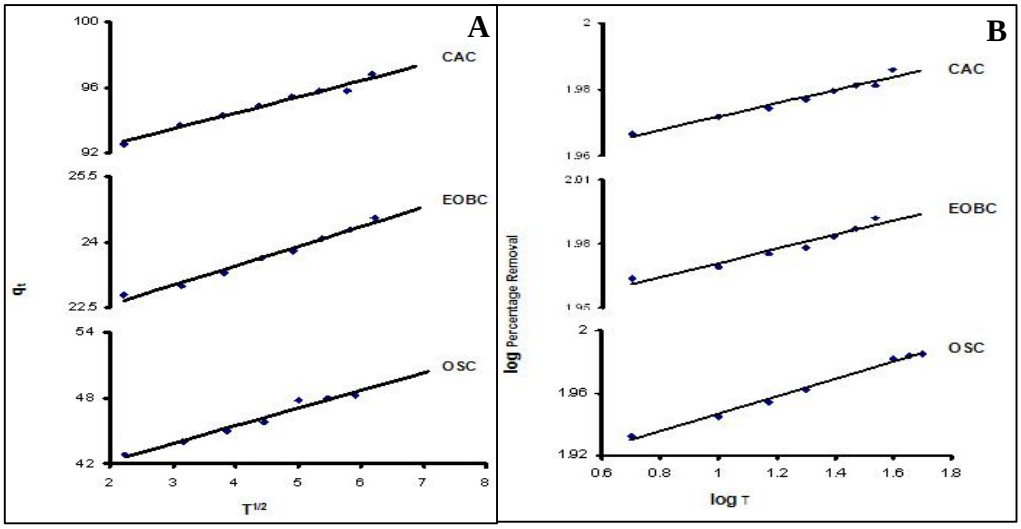

Figure 12. A. Intra particle diffusion plot B. Log Intra particle diffusion plot

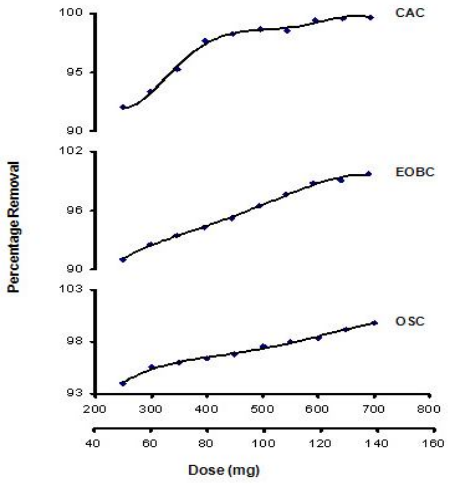

Figure 13. Effect of dose of adsorbent

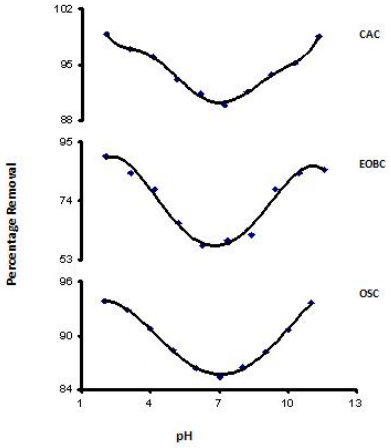

Figure 14. Effect of pH

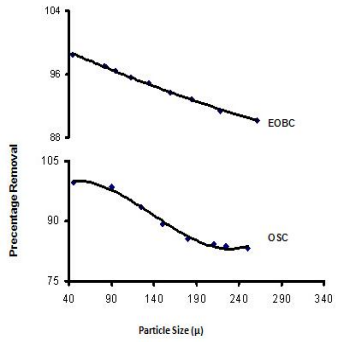

Figure 15. Effect of particle size variation

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RESEARCH ARTICLE

Post Monsoon Quality Assessment of Drinking Water Sources in Bidar City,India

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ABSTRACT

The water quality analysis of both surface and ground water used for water supply in the Bidar city, Karnataka was carried out for a period of 3 months after monsoon. The various drinking water quality parameters considered for the study included color, odor, taste, temperature, DO, turbidity, conductivity, pH, TDS, alkalinity, total hardness, calcium, magnesium, fluoride, sulphates, sodium, potassium, iron and most probable number (MPN).The total number of sampling stations were 48. The study showed that all the water quality parameters were within the limits of drinking water prescribed by both BIS and WHO.

Key words: Tap, Bore well, Drinking water, BIS, WHO, water quality analysis

INTRODUCTION

Water is commodity which exists on the surface and under the ground of earth; which is plentiful in quantity. Without water life of human being cannot sustain on the earth and has long been suspected of the source of much human illness. However the sources of water (surface and ground) are becoming increasingly contaminated due to increased industrial, agricultural and population effects, nearly 60% of diseases are due to pollution in drinking water (Peavey.H.S.1985).

As population increases demand for water will grow accordingly and at a much more alarming rate with improved leaving standard. The combination of theses to factors creates greater and greater stress on finding adequate supplies. Wherever, there is a shortage of water, inferior quality and polluted water is supplied to meet the demand anyhow (Loganayagi, A., 2008).

The problems faced by water supply agencies in developed countries are significantly different from those faced by developed countries. Therefore, continuous monitoring is required particularly in the areas of industrial set up (Peavey.H.S.1985).

The present study was aimed as evaluating the variations in the physio-chemical and bacteriological parameters of tap and bore well water which is supplied to the Bidar public for domestic purposes. An attempt was also made to identify the sources and extent of pollution and to have an integrated data which can be used an reference in the future. Bidar City (Karnataka) situated at north latitude $17^0$55' and east longitude $77^0$32' and is a important district head quarter of historical significance (Sikha Bishat, 2007).

MATERIALS AND METHODS

Sampling

Samples of tap and bore well water were collected in a clean high grade plastic bottles of one liter capacity. These bottles were rinsed thrice with the source water before samples were collected (APHA, AWWA-2000).

Preservation

To minimize the potential for volatilization or biodegradation between sampling and analysis, keep samples as cool as possible. Preferably pack samples in commercial ice substitute before transportation. Methods of preservation are limited and used generally to record biological action, retard hydrolysis of chemical compounds and complexes (APHA, AWWA-2000).

Analysis

Samples were brought to the laboratory and parameters like pH, TDS, DO, and temperature were measured immediately onsite with potable instruments. Other physio- chemical and bacteriological parameters were analyzed within 36 hours by preserving samples below 4^0cin a refrigerator. Standard methods were adopted for the analysis of water sample (APHA, AWWA-2000).The main source of water to the Bidar city is tap water. We have collected overall 48 samples from Bidar city, 35 samples from 35 wards tap water, wherever bore wells were observed, we have collected 13 samples from there. These bore wells are used whenever there is a shortage of water from tap (D.S. Saluja, 2008).

RESULTS AND DISCUSSION

The results obtained from physiochemical analysis of 48 samples collected from various sites of study area during Oct.-Dec.-2010 were compared with standards for surface and ground water by various authorities Viz. IS, WHO. Parameter wise results are compared as follows;

Colour

In natural waters, color may occur due to the presence of humic acid, folic acid, metallic ions, suspended matters, phytoplankton, weeds, and industrial effluents. In the present study, all the water samples were found to colorless. (Peavey.H.S.1985).

Odour & Taste

The odor may be of natural origin, caused by living & decaying aquatic organisms and accumulation of gases like ammonia and hydrogen sulphide etc. In the present study, all the water samples were found to be odorless. Taste in water is present mainly due to dissolved impurities often organic in nature. Many algae also impart taste to the water. In the present study, all the water samples have agreeable to pleasant taste (Peavey.H.S.1985).

Dissolved Oxygen

Dissolved oxygen reflects the physical and biological process prevailing in the water. Oxygen can be rapidly removed from the water by discharge of oxygen demanding wastes. Maximum dissolved oxygen concentration was recorded 7.9 mg/L at tap water sample at TW26 and the minimum mean concentration was recorded 6.9 mg/L at TW3 and mean minimum concentration was recorded 7.4 mg/L in bore well water sample. The average mean value of both the sample is 7.2 mg/L which is in the permissible limit of BIS (IS-10500).

Turbidity

The turbidity is caused by suspended matter, such as clay, slit, finely divided organisms and organic matter, soluble colored organic compounds and plankton and other microscopic. The max value observed is 3.0 NTU and minimum value is 1.0 NTU in both tap and bore water samples. The average mean value recorded as 2.0 NTU, Which is under permissible limit (Krishna Ram, H.etal, 2007).

Conductivity

Conductivity is a parameter which determines the suitability of water. It is a numerical expression of the ability of an aqueous solution to carry an electric current. This ability depends on the presence of ions, their total concentration, mobility, valance and µmhos/cm in the water. However the maximum mean conductivity is recorded as 1546 µmho/cm in bore water at BW3 and minimum conductivity is recorded 846 µ mho/cm in tap water at BW2, the

average mean of above two samples will be 1196 µmho/cm. As the concentration of dissolved salts increases conductivity also increases. BW3shows higher values of conductivity, which means that there is a high concentration of salts in bore well water and this is also confirmed by the presence of higher TDS in the respective samples where as conductivity in tap water is from 423 to 485 µmho/cm, to an average mean value of 454 µmho/cm, which is in the permissible limit (Saba Hasnain etal., 2008).

pH

The pH value of water is an important indicator of its quality, which depends on the carbon dioxide-carbonate-bicarbonate equilibrium. Particularly every phase of water supply and water treatment, for Ex. Acid base neutralization, water softening, precipitation, coagulation, disaffection and corrosion control is pH dependent and pH is used in alkalinity and CO2 measurement .The permissible limit of pH in drinking water is with in 6.5 to 8.5 according to BIS (IS-10500).

The values of pH in all the samples are with in the permissible range. The value of pH in tap water samples of study area ranges between 7.6 to 7.7at the tap samples. Bore well water value ranges between 6.4 to 7.7 and the mean average of all two samples is 7.66, which is in the permissible limit (Saba Hasnain etal. 2008).

Total Dissolved Solids

Solids refers to matter suspended or dissolved in the water, solids may affect water or effluent quality adversely in number of ways. Water with high dissolved solids generally is called impure waters. The mean values of TDS of the study area for tap water ranges from 280 to 328 mg/L, the average mean of tap water is 304 mg/L and bore well water ranges from 618 to 1035 mg/L with an average of 826mg/L. Higher values of TDS are observes in bore well samples and all are within the permissible limits (Shakthi, M. etal, 2008).

Alkalinity

Alkalinity of water is acid neutralization capacity. It is caused by the presence of different ions of carbonates, bicarbonates and hydroxyl ions. The study revels the alkalinity is maximum 240 mg/L at BW5 and Min. 140 mg/L at BW13and average mean of bore well water is 190mg/L and average mean of tap water is 195mg/L which is in the permissible limit of BIS.

However, alkalinity itself is not harmful to human being still the water having less than 100 mg/L is desirable for domestic use. The rate of decomposition of organic matter was usually accelerated due to increase in alkalinity (Garg, S.S.2003).

Total Hardness

Total hardness of water, caused by multivalent metallic cat ions varies considerably from place to place. The hardness of water reflects the geological formation with it has been in contact (Peavy.H.S.1985).In the study area maximum values of bore well water sample is recorded as 560mg/L and minimum of 160 mg/L with an average mean of is 360mg/L. In tap water sample maximum hardness is 240 and min. is 190mg/L with a average mean of 210mg/L, which is in the permissible limit of BIS.

Calcium

The presence of calcium in the water supplies results from passage through or over deposits of limestone, gypsum. The maximum permissible limit is 75 to 200 mg/L (BIS).

In the present study area calcium concentration is found to a mean of 121 mg/L of both the samples. While comparing higher calcium is observed in bore water. Low content of calcium in drinking water may cause rickets and defective-teeth. It is essential for nervous system, cardiac function and coagulation of blood.

Fluoride

Fluoride is known to contaminate ground waters globally. In India, its occurrence in top aquifer system is in many places of A.P., T.N., Rajasthan, Karnataka, Goa and Kerala. Fluoride concentration is less than 0.5 mg/L may be harmful and may cause dental caries. High concentration greater than 1.5 mg/L may cause Skelton fluorosis. In the study area the concentration of fluoride is recorded nil.

Sulphate

Most of the sulphate ions are probably derived from the solution of calcium & magnesium ions. Sulphate is naturally occurring ion found in all types of water and wide ranges in nature. The maximum permissible and allowable concentration of sulphate in drinking water is 200 to 400 mg/ L according to BIS. The concentration ranges between 20 to 52 mg/ L in bore water, with an average mean of 36mg/Land 11to 16mg/L in tap water, with an average mean of 14 mg/L, which is permissible for drinking purposes.

Chlorides

Its concentration is high in ground water where the temperature is high with less rainfall. Chloride concentration is also indicator of pollution by sewage. It is harmful up to 1000 mg/L.The concentration of chloride in study area were

recorded as 14to 68 mg/L in tap water samples, and a high concentration gradient is observed as 30 to 97 mg/ in bore well water sample. This is in the permissible limit of BIS.

Sodium and Potassium

Sodium and potassium ranks sixth and seventh among the harmed by a high sodium ratio and among the elements in order of abundance, respectively.The concentration of sodium in study area ranges from 89 mg/L to 127mg/L in tap water with an average value of 108 mg/L and 30 mg/L to 97 mg/L with an average mean of 64mg/L in bore well water. The concentration of potassium in bore water from 19 to 28 mg/L to an average value of 23mg/L and a average mean value of 22mg/L is observed in tap water all above concentrations are in the permissible limit of BIS.

Iron

Iron in drinking water may be present as geological sources, industrial wastes and domestic discharges. Excess amount of Fe (more than 10 mg/L) causes rapid increase in respiration, pulse rate and coagulation of blood vessels (WHO.1963).In the study area most of the samples recorded their concentration as nil. In some of the samples it is observed from 0.1 to 0.2 mg/L due to domestic discharges

Microbiological examination of water

From public health stand point the bacteriological quality of water is more important as the chemical quality. The principal indicator in the polluted water were in pathogens are or might be present, unable to multiply under conditions, when pathogens do not multiply (Trivedi, R.K., and Goel, P.K.1986.).In the present study while evaluating pathogens or micro-bacteria from the all samples of Bidar city by most probable test (MPN) were found negative

CONCLUSION

The present study revels most of the water samples were within the permissible limit of drinking water standards. In general, the consumer should be trained and created awareness regarding different water polluting sources and their effects. Providing adequate drainage system with proper treatment before disposal and removal of faulty constructed septic tanks and cesspools may restrict the deterioration of water quality. The situation is aggravated by the problem of water pollution. India is heading towards a front water crisis mainly due to improper management of water resources and environmental degradation and this has lead to a lack of access of safe water supply to millions of people. The fresh water crisis is already evidenced in many states, particularly in Tamil Nadu and West Bengal.

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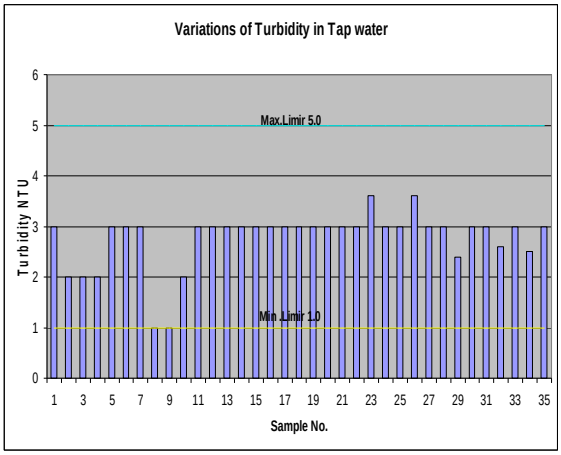
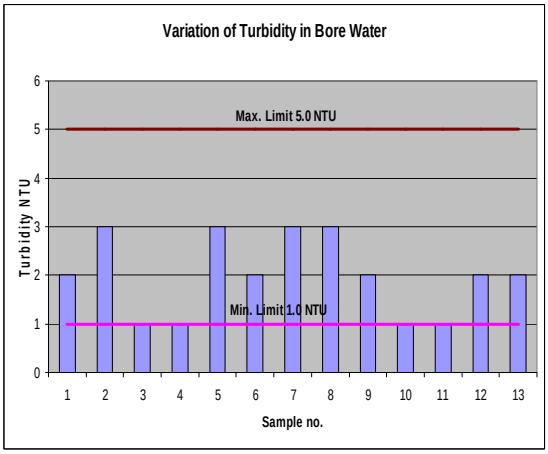
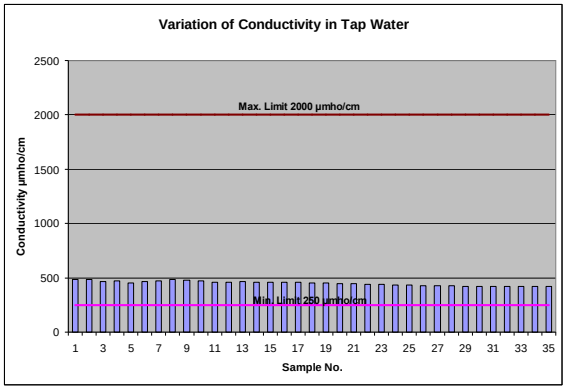
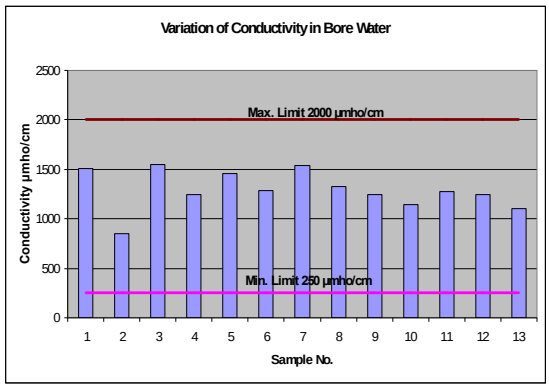
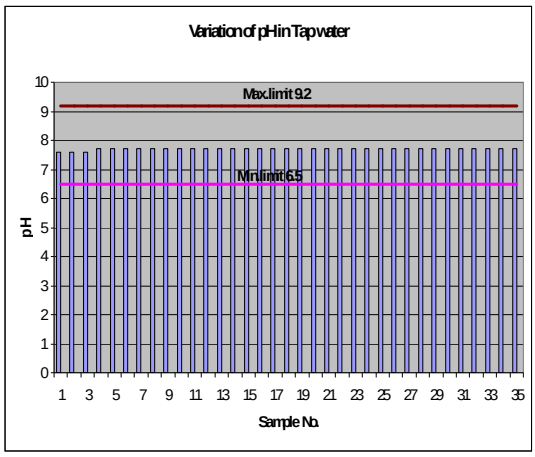
Graphs from analysis shows following natures and results from graphs are also considered while discussing results and discussions.

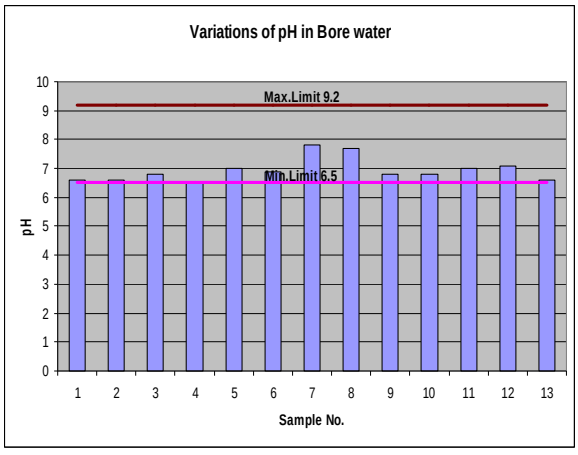


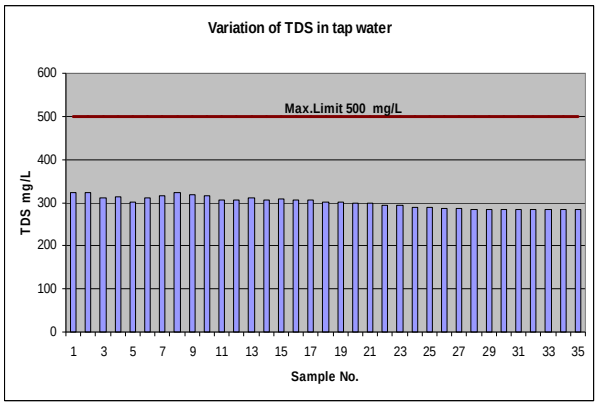


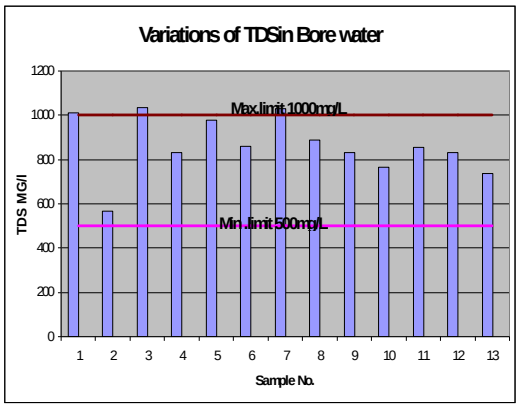









Variation of TDS in tap water
Max.Limit 500 mg/L
TDS mg/L
Sample No.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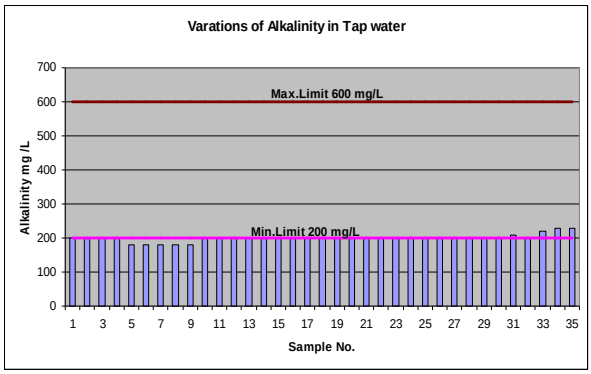
Min .limit 500mg/L
TDS MG/l
Sample No.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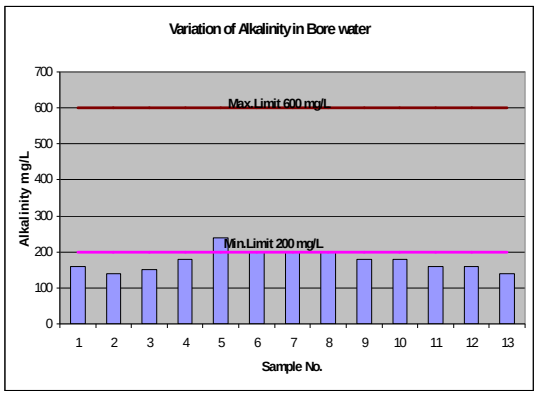
Max.Limit 600 mg/L
Min.Limit 200 mg/L
Alkalinity mg /L
Sample No.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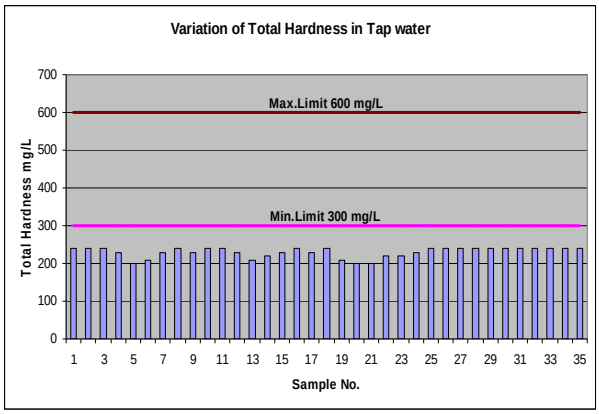
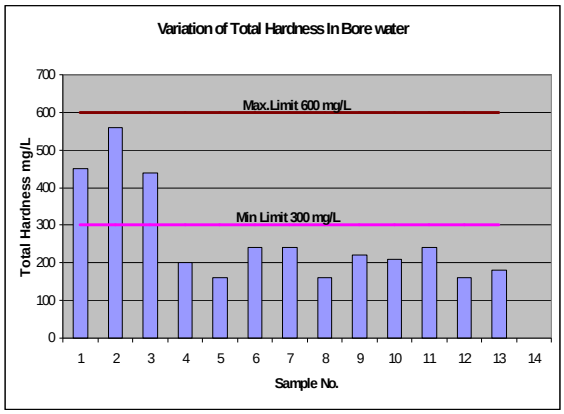

Variation of Total Hardness in Tap water
Max.Limit 600 mg/L
Min.Limit 300 mg/L
Total Hardness mg/L
Sample No.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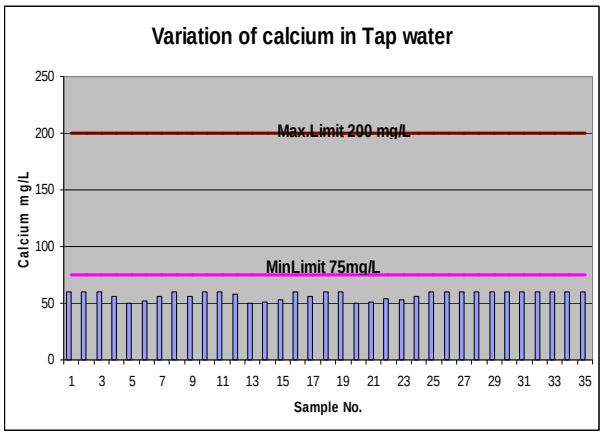
Min Limit 300 mg/L
Total Hardness mg/L
Sample No.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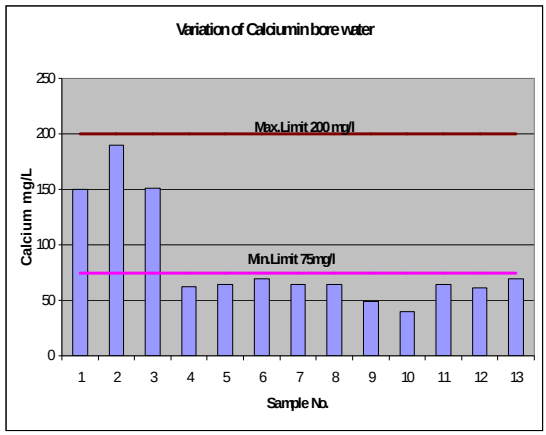
Max.Limit 200 mg/L
MinLimit 75mg/L
Calcium mg/L
Sample No.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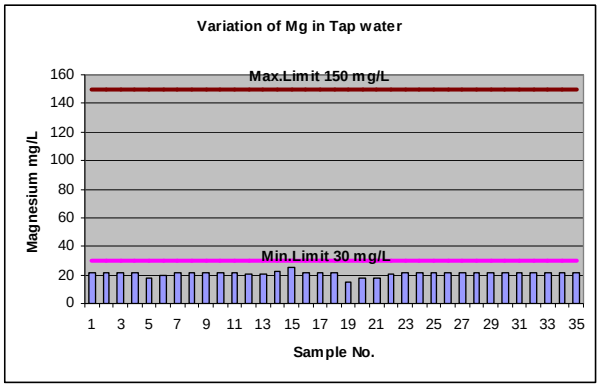
Min.Limit 75mg/l
Calcium mg/L
Sample No.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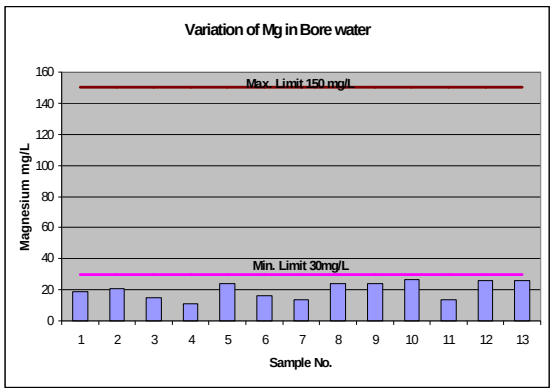
Max.Limit 150 mg/L
Min.Limit 30 mg/L
Magnesium mg/L
Sample No.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Min. Limit 30mg/L
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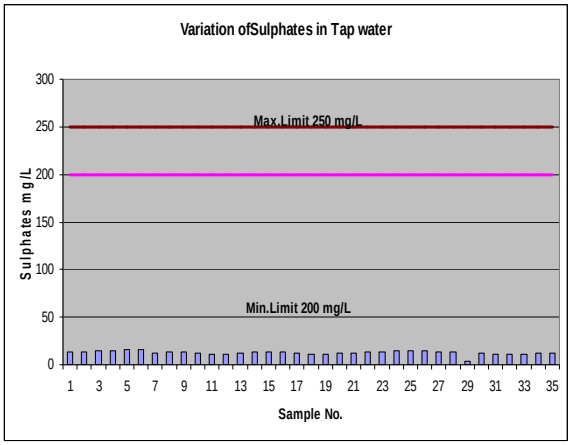
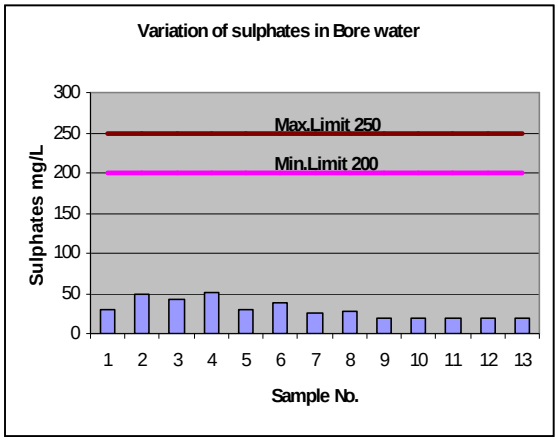

Variation ofSulphates in Tap water
Max.Limit 250 mg/L
Min.Limit 200 mg/L
Sulphates mg/L
Sample No.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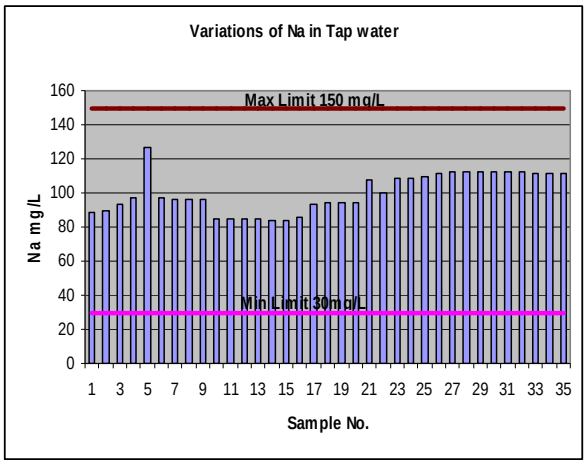
Min.Limit 200
Sulphates mg/L
Sample No.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Na mg/L
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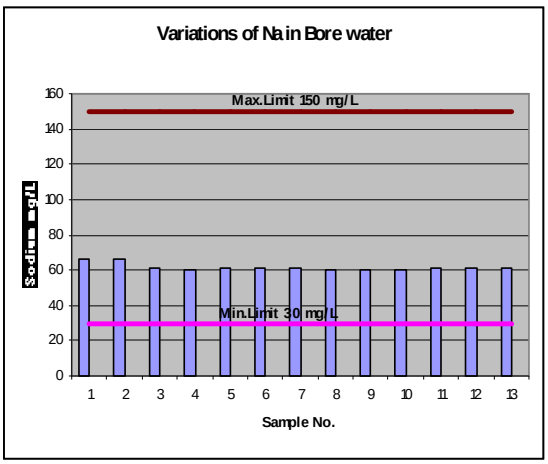
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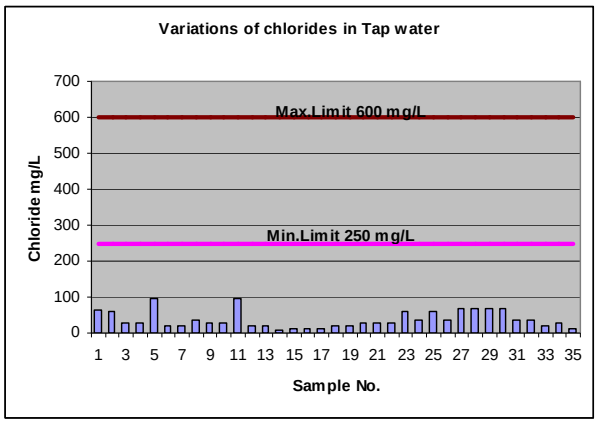
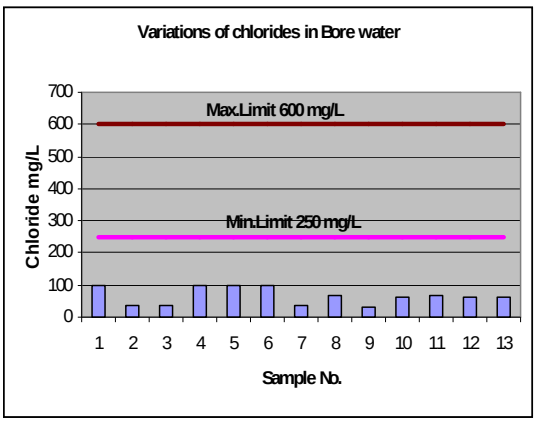
Max.Limit 150 mg/L
Min.Limit 30 mg/L
Sample No.


Variations of chlorides in Tap water
Max.Limit 600 mg/L
Min.Limit 250 mg/L
Chloride mg/L
Sample No.


Variations of chlorides in Bore water
Max.Limit 600 mg/L
Min.Limit 250 mg/L
Chloride mg/L
Sample No.

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RESEARCH ARTICLE

Survey of Ferns and Fern Allies from Kolli Hills, Eastern Ghats, Tamil Nadu, India

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ABSTRACT

The present study deals with the survey of available Pteridophytic plants, which are prevalent in study area. The botanical name, family, habitat and present status in Kolli hills have been given in this paper.

Keywords: Survey, Pteridophytes, Kolli hills, Eastern Ghats

INTRODUCTION

Pteridophytes are the seedless spore bearing vascular cryptogams which occupy a position between the lower non-seed bearing and higher seed bearing plants from a generally much neglected group of plants. About 250 millions years ago, they constituted the dominant vegetation on earth. India has a rich population of Pteridophytes, most of the species appear in either the Himalayan region or in the south Indian mountains called the Western and Eastern

Ghats. Most of the south Indian representatives of the Pteridophytes are found in the Western Ghats. The first Indian fern was described by Linnaeus and later amplified by Swertz floristic survey and taxonomical works began with British botanists, Beddome (1983) played an important role understanding and surveying south Indian ferns[1].

However, they are now replaced by seed bearing plants in the modern day flora. Pteridophytes grow luxuriantly in moist tropical and temperate forest. About 12, 000 species of Pteridophytes occur in the world flora of which about more than 1,000 species into 70 families and 191 genera likely to occur in India[2]. Recent studies shows that roughly 270 fern species found in south India, which comprise about 10 per cent of the region.

Status of Pteridophytic Flora in India

India, with a varied type of topography of climate is one of the richest regions of the world in ferns and ferns allies. Fern flora occupies the forest floor, on tree trunks and branches, in the niche of rock. The major floristic works previously done on South Indian ferns[3, 4 & 5]. Bed dome has recorded 211 species of fern from south India, Manickam (1986) has collected 140 species of ferns of the Palani hills.

Out of 1,000 species of Pteridophytes occurring in India, 170 species have been found to be used as food, flavour, dye, medicine, bio-fertilizers, oil, fiber and bio-gas production[4]. The medicinal value of Pteridophytes against bacteria, fungi, virus, cancer rheumatism, diabetes, inflammation, consultant, fertility, diuretic, pesticides, heptoprotective and sedative had been reported.The number of contributors about the taxonomy, ecology and distribution of Pteridophytes have been published from time to time. Fern flora occupies the forest floor, on tree trunks and branches, in the niche of rock. In the present study, an intensive survey was made over a period of 12 months from January 2006 to December 2006 with the following objectives. To list out the different ferns and fern allies from the Kolli hills.

Study Area

Kolli hills of Eastern Ghats lies in Namakkal District, Tamil Nadu is well known for its rich biological diversity. The Kollihills is flanked by Namakkal Taluk is on the north east and Tiruchirappali district in the east. The altitude ranges from 1000-1400 m rising to 1450 m at Kuzhivalavu (11 10 - 30 N and 75 15 - 30 E). Kollimalai is called as Chaturagiri or Square hill contain of high rising peaks and ravines. Slopes are quite steep forming several narrow and deep valleys and in same places rising abruptly from plains and generally steep near ridges.

Kollihills is drained by two rivers, Vasisthanadhi and Swetanadhi. Swetanadhi originates from Kolli hills and drains the northern side of Salem district. Vasisthanadhi is called as Pearar and originates from the Aranuttmalai, turns eastwards and which is an irrigation resource to Attur Taluk. Kolli Hills is an isolated hill range of the discontinuous Eastern Ghats mountain system situated in the Namakkal district of Tamil Nadu. Kollihills on the western, eastern and southern sides rise abruptly from the plains and are thickly forested.

MATERIALS AND METHODS

In the present study an intensive survey was made over a period of 12 months from January 2006 to December 2006. The field survey was made in the first week of every month in various places namely, Solakkadu, Semmedu area, Kuzhialavu shola, Nachiyar kovil, Arapallieswarar Kovil and Sengari shola in Kollihills.

During the course of survey ferns and ferns allies were collected and the herbarium was made. All the specimens were compared and identified with Classification of Holttum (1949) [6] and the standard herbarium available in St. Xavier's College, Palayamkottai - Tirunelveli, Tamilnadu, India. The voucher specimens were kept and preserved in the Department of Botany and Microbiology, A.V.V.M. Sri Pushpam College, Thanjavur District, Tamilnadu, India.

RESULTS AND DISCUSSION

About 80 species of ferns and ferns allies comprising 37 genera with 28 families have been collected and identified in different places of Kollihills (Table 1).Distribution of ferns in the Kollihills showed a wide range of variations. Most of the ferns and ferns allies have been frequently sighted inside the shola vegetation. This may be explained that shola vegetation provides an ideal microclimatic condition in terms of lower temperature, higher percentage of humidity, frequent rainfall and humus containing soil. It is a common fact, that during rainy season all kinds of plants including ferns, exhibited a very luxurious growth in the community. Since the ferns are highly sensitive to water (March, April). The Pteridophytes showed a poor appearance when compared to the flowering plants.

During exploration, it was frequently observed that some of the ferns such as *Angiopteris* with *Cyathea, Drynaria* with *Asplenium, Blechnum* with *Dicranopteris, Selaginella* with *Hemionitis* are having higher degree of association. This may be explained that the specific root exudates, which may prefer the growth of specific plants. In Kolli Hills some selective ferns namely *Selaginella tenera, Hyperzia phlegmaria* an epiphytic fern showed their rare occurrence. This may be due to the habitat loss, over exploitation by local people for medicinal purposes and host specificity in the case of epiphytic ferns particularly.

Direct observation showed that in the Kollihills, several ferns such as *Drynaria, Selaginella, Hyperzia,* etc., are being collected by the local people for preparation of medicines to cure various diseases. Similarly the rhizome of *Angiopteris* and the stem of *Cyathea* are collected and kept in the pooja room. Every year many ferns and ferns allies namely, *Adiantum* species, *Dicranopteris, Pteris* species have been collected as study materials so far as the distribution of ferns in the Kolli Hills are concerned. *Hyperzia, Selaginella, Ceratopteris* exhibited very rare occurrence. Only few patches of *Dicranopteris* were sighted on the road side. Many ferns and ferns allies seem to decline due to over exploitation and habitat distribution in the Kolli Hills.

Table 1. List of ferns identified from Kollihills

Sl. No.	Genus	Species	Family	Habitat	Distribution Pattern
1.	*Hyperzia*	*phlegmaria*	Lycopodiaceae	-E-	-F-
2.	*Lycopodium*	*cernua*	Lycopodiaceae	-T-	-C-
3.	*Selaginella*	*wightii*	Selaginellaceae	-L-	-R-
4.	*Selaginella*	*radicata*	Selaginellaceae	-T-	-F-
5.	*Selginella*	*tenera*	Selaginellaceae	-T-	-C-
6.	*Psilotum*	*nudum*	Psilotaceae	Ep&L	-R-
7.	*Ophioglossum*	*reticulatum*	Ophiogloseae	-T-	-R-
8.	*Botrychium*	*lanuginosum*	Ophiogloseae	-L-	-R-
9.	*Angiopteris*	*evecta*	Angiopteridaceae	-T-	-C-
10.	*Lygodium*	*microphyllum*	Schizaeaceae	-T-	-R-

11.	*Anemia*	*wightiana*	Schizaeaceae	-T-	-C-
12.	*Pteris*	*vitata*	Pteridaceae	-T-	-R-
13.	*Pteris*	*multiaurita*	Pteridaceae	-T-	-R-
14.	*Pteris*	*pellucida*	Pteridaceae	-T-	-C-
15.	*Pteris*	*cretica*	Pteridaceae	-T-	-F-
16.	*Pteris*	*biaurita*	Pteridaceae	-T-	-C-
17.	*Pteris*	*argyraea*	Pteridaceae	-T-	-C-
18.	*Pteris*	*confusa*	Pteridaceae	-T-	-C-
19.	*Actinopteris*	*radiata*	Actinopteridaceae	-T&L-	-C-
20.	*Doryopteris*	*concolar*	Sinopteridaceae	-T-	-C-
21.	*Pellaea*	*falcata*	Sinopteridaceae	-T-	-O-
22.	*Pellaea*	*boivini*	Sinopteridaceae	-L-	-F-
23.	*Cheilanthes*	*farinosa*	Sinopteridaceae	-L-	-C-
24.	*Cheilanthes*	*mysurensis*	Sinopteridaceae	-T-	-R-
25.	*Cheilanthes*	*tenuifolia*	Sinopteridaceae	-L&T-	-C-
26.	*Ceratopteris*	*thalictroides*	Parkeriaceae	-T-	-C-
27.	*Hemionitis*	*arifolia*	Hemionitidaceae	-T-	-C-
28.	*Pityrogramma*	*calemelonos*	Hemionitidaceae	-T-	-C-
29.	*Pityrogramma*	*calemelones var aureoflava*	Hemionitidaceae	-T-	-C-
30.	*Adiantum*	*incisum*	Adiantaceae	-T-	-C-
31.	*Adiantum*	*lunulatum*	Adiantaceae	-T-	-C-
32.	*Adiantum*	*raddianum*	Adiantaceae	-T,L-	-C-
33.	*Vittaria*	*elongata*	Vittariaceae	-E-	-C-
34.	*Antrophyum*	*plantagineum*	Vittariaceae	-E,L-	-R-
35.	*Pteridium*	*aquilinum*	Dennstaedtiaceae	-T-	-C-
36.	*Microlepia*	*platyphylla*	Dennstaedtiaceae	-T-	-C-
37.	*Odontosoria*	*chinensis*	Lindsaeaceae	-T-	-C-
38.	*Lindsaea*	*encifolia*	Lindsaeaceae	-T-	-C-
39.	*Lindsaea*	*malabarica*	Lindsaeaceae	-T-	-R-
40.	*Lindsaea*	*heterophylla*	Lindsaeaceae	-T-	-C-
41.	*Leucostegia*	*immerse*	Davalliaceae	-E-	-C-
42.	*Araistegia*	*pulchra*	Davalliaceae	-T,L-	-C-
43.	*Nephrolepis*	*auriculata*	Olendraceae	-T-	-C-
44.	*Nephrolepis*	*multiflora*	Olendraceae	-T-	-R-
45.	*Hymenophyllum*	*denticulatum*	Hymenophyllaceae	-E,L-	-R-
46.	*Hymenophyllum*	*javanicum*	Hymenophyllaceae	-L-	-R-
47.	*Trichomanes*	*sexifragoides*	Hymenophyllaceae	-E,L-	-C-

48.	*Trichomanes*	*plicatum*	Hymenophyllaceae	-E-	-C-
49.	*Dicarnopteris*	*linearis*	Gleicheniaceae	-T-	-C-
50.	*Cyathea*	*gigantea*	Cyatheaceae	-T-	-C-
51.	*Macrothelpteris*	*torresiana*	Thelipteridaceae	-T-	-C-
52.	*Pseudocyclosorus*	*tylodes*	Thelipteridaceae	-T-	-C-
53.	*Pseudocyclosorus*	*octothodes*	Thelipteridaceae	-T-	-C-
54.	*Sphaerostephanos*	*arbuscula*	Thelipteridaceae	-T-	-C-
55.	*Christella*	*parasitica*	Thelipteridaceae	-T-	-C-
56.	*Christella*	*dentata*	Thelipteridaceae	-T-	-C-
57.	*Asplenium*	*decrescens*	Aspleniaceae	-T-	-C-
58.	*Asplenium*	*indicum*	Aspleniaceae	-E,L-	-C-
59.	*Asplenium*	*inaequilaterale*	Aspleniaceae	-T-	-C-
60.	*Asplenium*	*lancinatum*	Aspleniaceae	-E,L-	-R-
61.	*Asplenium*	*aethiopicum*	Aspleniaceae	-T-	-C-
62.	*Athyrium*	*solenopteris*	Athyriaceae	-T-	-C-
63.	*Diplazium*	*esculentum*	Athyriaceae	-T-	-C-
64.	*Diplazium*	*polypodioides*	Athyriaceae	-T-	-C-
65.	*Tectaria*	*codunata*	Dryopteridaceae	-T-	-C-
66.	*Polystichum*	*molluccense*	Dryopteridaceae	-T-	-C-
67.	*Arachniodes*	*aristata*	Dryopteridaceae	-T-	-C-
68.	*Dryopteris*	*cochleata*	Dryopteridaceae	-T-	-C-
69.	*Dryopteris*	*sparsa*	Dryopteridaceae	-T-	-C-
70.	*Bolbitis x*	*prolifera*	Lomariopsidaceae	-T-	-C-
71.	*Blechnum*	*orientale*	Blechnaceae	-T-	-C-
72.	*Leptochillus*	*decurrens*	Polipodiaceae	-T-	-C-
73.	*Drynaria*	*quercifrlia*	Polipodiaceae	-E,L-	-C-
74.	*Pyrrosia*	*lanceolata*	Polipodiaceae	-E,L-	-C-
75.	*Pyrrosia*	*porosa*	Polipodiaceae	-T-	-C-
76.	*Microsorium*	*punctatum*	Polipodiaceae	-E-	-C-
77.	*Pleopeltis*	*macrocarpa*	Polipodiaceae	-E,L-	-C-
78.	*Lepisorus*	*nidus*	Polipodiaceae	-E-	-C-
79.	*Marsilea*	*minuta*	Marsileaceae	-A,Sa-	-C-
80.	*Azolla*	*pinnata*	Azollaceae	-A-	-C-

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RESEARCH ARTICLE

Groundwater Quality Assessment in Selected Locations of Lucknow, Uttar Pradesh, India

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ABSTRACT

A preliminary study was conducted to assess the status of groundwater quality in Lucknow city. Seven groundwater samples were collected from Lucknow city during post-monsoon season (October to December, 2010). The physico-chemical characteristics of groundwater samples were analyzed as per American public health association standard methods. The physico-chemical analysis data reveals except magnesium, nitrate, phosphate, iron and manganese all parameters are recorded within the prescribed standard limit for drinking water. Maximum concentration of iron, manganese and zinc were recorded as 0.08, 0.07, 0.08 mg/l, respectively. Iron and Manganese levels were recorded higher than the prescribed limit of world health organizations. Municipal sewage, septic tank leakage and leaching from solid wastes are the suspected source of groundwater pollution in the study area.

Key words : Groundwater, physico-chemical characteristics, heavy metals, anthropogenic pollution

INTRODUCTION

Scarcity of drinking water is one among important issue in twenty-first century. Rapid and unregulated industrialization, urbanization and agricultural activities during last few decades have deteriorated the surface water and groundwater quality in India. Groundwater is an imperative natural resource for meeting water requirements for domestic, agricultural and industrial sector. In India, nearly 70% of population depend groundwater for their drinking water needs. Untreated industrial effluents and municipal sewages leaching, lack of sanitation, improper waste disposal and lack of water source protection leads to increased groundwater contamination and about 40% of the diseases outbreak were attributed to polluted groundwater consumption [1]. Decline of water quality in general and groundwater in particular is of great concern in India. Studies on groundwater quality monitoring would help to identify safe zones for drinking water and provide solution to the quality problems in groundwater by means of hydrogeological and geochemical data. In this context, the present study was conducted to assess the status of groundwater quality in Lucknow.

MATERIALS AND METHODS

Lucknow is the capital of Uttar Pradesh and it is geographically located at 26°030'- 27°010' North and 80°030' – 81°013' East. River Gomati flows through the Lucknow city. The annual average rainfall is around 814.6 mm. In Lucknow, there are 39 large and medium scale industries, 12058 small-scale industries, and 21895 handicraft industries are located in the district. Geologically, the area falls under two geologic units namely younger and older alluvial plains. The younger alluvial plain lies all along the river Gomti and forms a wide flood plain. The older alluvial plain occupies higher level than younger alluvial plain along with uplands and as natural levies, paleo channels and meander scars.

Groundwater samples were collected in acid washed polythene bottles from Lucknow city in seven stations during post-monsoon season (October to December, 2010). The groundwater sampling stations are shown in figure 1. The parameter such as pH, electrical conductivity and total dissolved solids were measured in the field using portable water monitoring kit (make: Deep vision). Total alkalinity, total hardness, calcium, magnesium, chloride were estimated by titration method. Sodium and potassium level was measured using flame photometer (make: Systronics). Sulphate, nitrate and phosphate were estimated spectrophotometrically. All the analysis was carried out as per standard methods of APHA [2]. The results obtained were evaluated in accordance with the norms prescribed under Bureau of Indian Standards (BIS) [3] and World Health Organization (WHO). Correlation analysis was performed using Statistical Package for Social Sciences (SPSS) software.

RESULTS AND DISCUSSION

Descriptive statistics of groundwater quality characteristics are given in Table 1. The pH level of groundwater samples ranged between 7.0 and 7.9 with a mean of 7.43. In the present study, all the groundwater samples fall under the maximum permissible limit recommended by standards of World Health Organization (6.5 to 9.2). According to Rajesh et al. [4], low pH level in groundwater may cause gastrointestinal disorders like hyper acidity, ulcers, and stomach pain with burning sensation. Electrical conductivity is an indicative of the total concentration of total dissolved ions in water [5]. In the present study, the electrical conductivity and total dissolved solids (TDS) level was recorded between 0.64-1.17 mS/cm and 391 – 720 mg/l, respectively. Elevated level of TDS in groundwater is

generally not harmful to human beings but high concentration of these may affect persons, who are suffering from kidney and heart diseases [6]. However, high solids may cause laxative or constipation effects.

Alkalinity of groundwater samples varied between 128 and 298 mg/l with a mean level of 201.1 mg/l. Maximum level of alkalinity was recorded at Shivari (298 mg/l) followed by Palenda (275 mg/l). Fluctuations in the alkalinity level indicate dilution of pollution load [7]. In the present study, all the groundwater samples fall within the permissible limit (500 mg/l) of World Health Organization.

In the present investigation, level of total hardness recorded between 30 and 265 mg/l. Desirable limit of total hardness is 300 mg/l however in the absence source it is permissible up to 600 mg/l [8]. Concentration of total hardness up to 60 mg/l is soft, 61-120 mg/l is moderately hard, 121 - 180 mg/l is hard and above 180 mg/l is very hard. In Lucknow, half numbers of ground water samples falls under the very hard category (> 180). High values of hardness between 150 – 300 mg/l may cause kidney problem [9].

Principal cations imparting hardness are calcium (Ca) and magnesium (Mg). The mean level of Ca is recorded as 20.9 mg/l. Except few samples, all the groundwater samples are within the desirable limit of Ca (75 mg/l: Bureau of Indian Standards [10]). Concentration of Mg figured between 19 and 237 mg/l. High concentration of Mg may be cathartic and diuretic [11]. Combined effect of Mg with sulfate may lead to laxative effect in human beings [12]. The maximum permissible and highest desirable limit given by the WHO and BIS are 100 and 30 mg/l, respectively.

Concentration of chloride (Cl) in groundwater samples figured between 42 and 139 mg/l. All the groundwater samples were within the desirable limit of 250 mg/l [11]. Moderate level of Cl recorded at Palenda probably attributed to leaching of chloride rich industrial effluents, untreated sewage and municipal waste. High concentration of chloride is injurious to people suffering from diseases of heart or kidney [11]. Sodium (Na) and potassium (K) are the most important minerals occurring naturally. Concentration of Na and K were ranged from 48 to 72 and 6 to 13, respectively. According to Srivastava [13], elevated level of Na may adversely affect the cardiac, renal and circulatory functions. Level of sulphate was observed between 21 and 155 mg/l.

Concentration of phosphate was observed from 0.12 to 0.34 mg/l.The phosphate values exceeded the permissible limit (0.1 mg/l) of US Public Health Standards [8]. Maximum level was observed at Hordoia (0.34 mg/l) suggests notable contribution from untreated municipal sewage. High concentration of phosphate is indicative of pollution and the major source of anthropogenic phosphorus is sewage, detergents, agricultural effluents, and fertilizers [14]. Sulphate values in all sampling stations were well below the prescribed by Bureau of Indian standards limit (400 mg/l). Baruah et al. [15] reported the high concentration of sulfates in the ground water attributed by the untreated industrial and domestic waste effluents.

The level of nitrate was observed between 8 and 15 mg/l with a mean level of 10.7 mg/l. Nitrate concentration of 10 mg/l or greater is considered as an indication of contamination [16] and nitrate level of 8.5 mg/l are considered to be in the category of low level contamination [17]. Generally, the major sources for nitrate in groundwater include domestic sewage, runoff from agricultural fields, and leachates from landfill sites [18-19]. According to WHO, desirable limit of nitrate is 45 mg/l. In the present study, all samples fall within the standard limit (45 mg/l).
In the present study, fluoride content in all groundwater samples fall under the optimum concentration of 1.5 mg/l, as recommended by World health organization. Weathering of rocks, phosphatic fertilizers usage and sewage sludge application are major sources of fluoride in groundwater [20]. Fluoride at low level (less than 1 mg/l) in drinking water has been considered beneficial but high level may leads to dental fluorosis (tooth mottling) and more seriously skeletal fluorosis [21]. Long term exposure of fluoride in high concentration may lead to thyroid functional disorders and neurological effects [22-23].

Iron (Fe) concentration was ranged between 0.03 and 0.08 mg/l with mean level of 0.5 mg/l. Most of the samples contain concentration of Fe higher than guideline level of 300 µg/l [24]. Maximum level recorded at Palenda (0.08

mg/l) may be due to rusting of casing pipes, non-usage of bore wells for long periods and disposal of scrap iron in open areas due to industrial activity [25]. Concentration of Manganese (Mn) and Zinc (Zn) recorded in the range between 0.02 - 0.07 mg/l and 0.01-0.08 mg/l, respectively. Leaching of industrial effluents, liquid manure, composted materials and agrochemicals are main sources of Zn pollution [26-27]. In all the sampling locations Zn concentration was observed within the permissible limit of 3 mg/l [24]. However, Mn level was 2 to 8 folds higher than the prescribed limit of 0.1 mg/l.

To understand the relationship among various physicochemical parameters, correlation analysis was carried out and given in Table 2. Positive correlation between total hardness and calcium indicates that notable contribution of calcium in the total hardness than magnesium in the ground water was inferred. Strong positive correlation was observed between TDS and alkalinity, sodium and potassium.

CONCLUSION

The physico-chemical characteristics of groundwater samples reveal most of the parameters are within the prescribed standard limit for drinking water. However, magnesium, nitrate, phosphate, iron and manganese concentrations clearly indicate groundwater pollution in the region. Municipal sewage, septic tank leakage and leaching from solid wastes are the suspected source of groundwater pollution. Since, urbanization rate in Lucknow city is much higher than other cities in India may further aggravate the pollution level in future. Hence, Implementation of integrated water resource management practices is paramount necessary in order to avoid the further deterioration

Table 1. **Descriptive statistics of groundwater characteristics in Lucknow**

Parameter	Unit	Minimum	Maximum	Mean	Std.dev
pH	--	7.0	7.9	7.43	0.26
EC	mS/cm	0.64	1.17	0.87	0.17
TDS	mg/l	391	720	534.60	104.26
Alkalinity	mg/l	128	298	201.07	46.59
Total Hardness	mg/l	30	265	122.87	78.17
Calcium	mg/l	17	50	20.89	17.98
Magnesium	mg/l	19	237	87.80	79.59
Sodium	mg/l	48	72	45.54	12.8
Potassium	mg/l	6	13	8.42	2.42
Sulphate	mg/l	21	155	66.27	39.89
Fluoride	mg/l	0.30	0.90	0.70	0.16
Chlorides	mg/l	42	139	71.73	27.16
Nitrate	mg/l	8	15	10.73	2.37
Phosphate	mg/l	0.12	0.34	0.18	0.08
Iron	mg/l	0.03	0.08	0.05	0.02
Manganese	mg/l	0.02	0.07	0.04	0.02
Zinc	mg/l	0.01	0.08	0.04	0.02

Table 2. Correlation between physico-chemical characteristics of groundwater

	pH	EC	TDS	Alkalinity	Hardness	Ca	Mg	Na	K	Cl	PO_4	NO_3	SO_4	F	Fe	Mn	Zn
pH	1																
EC	-.183	1															
TDS	-.171	1.0**	1														
Alkalinity	-.239	.878*	.877**	1													
Hardness	.542*	.084	.093	.051	1												
Ca	.546*	-.065	-.057	-.381	.612*	1											
Mg	-.423	.289	.282	.038	-.745**	-.070	1										
Na	-.101	.791*	.790*	.714**	.216	.069	.145	1									
K	-.150	.103	.095	-.028	-.229	-.293	.157	.102	1								
Cl	.482	.308	.317	.085	.896**	.772**	-.399	.391	-.139	1							
PO_4	.225	-.281	-.282	-.354	.031	.449	.171	-.236	-.267	.024	1						
NO_3	-.243	.94**	.939**	.754**	-.073	.039	.530*	.773**	.046	.224	-.096	1					
SO_4	-.097	.400	.398	.024	-.355	.377	.868**	.288	-.007	.052	.247	.628*	1				
F	-.051	.556*	.557*	.415	.420	.396	-.017	.612*	-.160	.557*	-.226	.566*	.284	1			
Fe	.316	.045	.055	.142	.707**	.367	-.625*	.146	-.579*	.559*	-.069	-.048	-.336	.519*	1		
Mn	.209	.536*	.545*	.232	.586*	.570*	-.066	.577*	.193	.799**	-.079	.481	.287	.573*	.240	1	
Zn	-.414	.719*	.713**	.821**	-.317	-.598*	.266	.476	.205	-.268	-.364	.681	.077	.193	-.135	-.02	1

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

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RESEARCH ARTICLE

Bio diesel Production from Algae

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ABSTRACT

The scarceness of fossil based fuels and the environmental impact produced by the conventional sources of energy over the planet, has lead new research work to seek the sustainable sources of clean energy. Biofuel is committed to becoming a worldwide leader in the development and deployment of renewable energy resources. Biodiesel is an alternative fuel, made from renewable biological sources. Biodiesel can also be produced from microbial sources like algae, bacteria and fungi. Algae exhibit the capacity to accumulate intracellular lipids in excess of 70 percent of their biomass during metabolic stress periods. Algal lipids as a source for biodiesel was less studied. Hence the algal lipids source as diesel fuel was taken for this study.

Key words: Algal lipids, Alternative fuel and Biodiesel.

INTRODUCTION

The rapid growth of world's population and increased growth of industrialization leads to the increased need for energy. A major challenge faced by the man kind is the gradual and in escapable exhaustion of the earth fossil energy sources. The combustion of these energy materials lavishly used for heating of transportation fuels is one of the key factor responsible for global warning and environmental pollution. The world is facing declining liquid fuel reserves at a time, when energy demand is exploding [1].If consumption continues at the current rate, the fossil fuel supply could be gone before the end the century. Renewable biofuels are needed to displace petroleum derived transport fuels, which contribute to global warming and are of limited availability. Biodiesel is potential renewable fuels that

have attracted the most attention. Biodiesel from microalgae seems to be the only renewable biofuel that has the potential to completely displace petroleum-derived transport fuels without adversely affecting supply of food and other crop products.[2] Renewable, carbon neutral transport fuels are necessary for environmental and economical sustainability. [3]

The use of microbial systems for biodiesel production although not exploited industrially until now. Now this ability of microorganism to grow on an almost infinite variety of food source may play a significant role in building out society from its current energy crisis. Increasing interest is generated to explore ways to reduce the high cost of bio diesel especially the lost of the raw materials [4]. In addition, microbes can be tailored to utilize varies carbon sources as feed stock for production of oils, such as waste or agriculture by product. Many molds, yeast and algae exhibit the capacity to accumulate intracellular lipids in excess of 70 percent of their biomass during metabolic stress periods [5].However little information only available on the use of microbial sources for lipid production, Hence this present study was undertaken to exploits the microbes for biofuel production and to optimize the conditions for higher lipids production from oleaginous algae.

MATERIALS AND METHODS

Collection of sample for algal culture

Algal samples were collected from TNAU (Tamil Nadu Agricultural University), coimbatore and Mandapam (Rameshwaram). *Botryococcus braunii, Chlorella vulgaris* (TNAU) and *Spirulina sp* (Mandapam) in order to isolate the algae for lipid production.26g of each species were taken. Collect the algal samples from various water sources using different types of plastic or glass containers and then subculture was done.

Characterization of algae

Algae collected were isolated and identified. It was carried out in laboratory condition with the proper supply of nitrogen, supplied with a feed of air/CO2 (4%) mixture delivered at a total gas flow rate of 60 mL/min bubbled through an aquafizz 1 inch and temperature maintained at 37^{o}C and optimum pH were maintained with light supply provided and grown in polythene bags. Every two days, the algae were examined for growth using an optical microscope. Continuous observation was done and the algae were maintained in condition and grown for two weeks. During the cultivation, cell density, temperature, and pH were recorded daily.

pH

The pH range for most cultured algal species is between 7 and 9, with the optimum range being 8.2-8.7. Complete culture collapse due to the disruption of many cellular processes can result from a failure to maintain an acceptable pH. The latter is accomplished by aerating or mixing the culture. In the case of high-density algal culture, the addition of carbon dioxide allows to correct for increased pH, which may reach limiting values of up to pH 9 during algal growth.

Aeration and mixing

Mixing is necessary to prevent sedimentation of the algae, to ensure that all cells of the population are equally exposed to the light and nutrients, to avoid thermal stratification (e.g. in outdoor cultures) and to improve gas exchange between the culture medium and the air. The latter is of primary importance as the air contains the carbon source for photosynthesis in the form of carbon dioxide. For very dense cultures, the CO2 originating from the air (containing 0.03% CO2) bubbled through the culture is limiting the algal growth and pure carbon dioxide may be

supplemented to the air supply (e.g. at a rate of 1% of the volume of air). CO2 addition furthermore buffers the water against pH changes as a result of the CO2/HCO3- balance.

Depending on the scale of the culture system, mixing is achieved by stirring daily by hand (test tubes, Erlenmeyer's), aerating (bags, tanks), or using paddle wheels and jet pumps in open ponds. However, it should be noted that not all algal species can tolerate vigorous mixing and you will need to know or experiment to create the best algae growing conditions.

Temperature

The optimal temperature for phytoplankton cultures is generally between 20 and 24°C, although this may vary with the composition of the culture medium, the species and strain cultured. Most commonly cultured species of micro-algae tolerate temperatures between 16 and 27°C. Temperatures lower than 16°C will slow down growth, whereas those higher than 35°C are lethal for a number of species.

Light

As with all plants, algae photosynthesize, i.e. they convert carbon dioxide into organic compounds, especially sugars, using the energy from light. As light is the source of energy for this process the intensity, spectral quality and photoperiod need to be considered. Light intensity plays an important role, but the requirements vary greatly with the culture depth and the density of the algal culture: at higher depths and cell concentrations the light intensity must be increased to penetrate through the culture (e.g. 1,000 lux is suitable for some small lab flasks, but 5,000-10,000 might be required for larger volumes).

Light may be natural or supplied by fluorescent tubes. Too high light intensity (e.g. direct sun light, small container close to artificial light) may result in photo-inhibition. Also, overheating due to both natural and artificial illumination should be avoided. Fluorescent tubes emitting either in the blue or the red light spectrum should be preferred as these are the most active portions of the light spectrum for photosynthesis. The duration of artificial illumination should be minimum 18 hours of light per day, although cultivated phytoplankton develops normally under constant illumination.

Nitrogen source

Nitrogen (N) and phosphorus (P) are the primary nutrients of concern in relation to water quality issues because they can stimulate primary productivity. The major forms of N and P found in natural waters. Nitrogen is present in the environment as organic nitrogen (i.e. bound to organic matter), nitrogen gas (N_2), nitrate (NO_3^-), nitrite (NO_2^-), and ammonium (NH_4^+). Organic nitrogen exists in both a dissolved and a particulate form in aquatic environments. Organic nitrogen includes urea, proteins, individual amino acids, as well as other, more complex biomolecules and it is found within living organisms and decaying plant and animal tissues. The sum of NH_4^+, NO_3^-, and NO_2^- is usually referred to as dissolved inorganic nitrogen (DIN). Although N_2 is inorganic and sparingly soluble in water, it is not considered DIN as it is generally not biologically available.

Primary producers, such as algae, preferentially take up NH_4^+ but also use $NO_3^-$and rarely, NO_2 [6] Nitrification-denitrification pathways result in the loss of NH_4, and it is regenerated by excretion and decomposition. Nitrate is commonly used as a measure of available N because it is the most oxidized form, organic N can be hard to measure, and NH_4^+' is often converted to NO3- or taken up by terrestrial vegetation before it reaches open water [6]. Ammonium that leaches from land to streams can be exported as such or converted to NO3- via nitrification in-stream [7], [8].

Photo reactor [6]

Algae cultivation can be achieved in two ways: open ponds and photobioreactors (PBR). A photobioreactor is closed equipment which provides a controlled environment and enables high productivity of algae. As it is a closed system, all growth requirements of algae are introduced into the system and controlled according to the requirements. PBRs facilitate better control of culture environment such as carbon dioxide supply, water supply, optimal temperature, efficient exposure to light, culture density, pH levels, gas supply rate, mixing regime, etc.,

Biomass estimation [9]

Take the algal cultures grown in BG-11 medium for three weeks period and wash cells with distilled water after centrifugation at 5000 rpm, collect the pellet and dry in hot air oven. Gravimetrically determine the dry weight of algal biomass and express the growth in terms of dry weight. Compare the biomass production potential of different algal cultures

Biochemical characterization of algae
Extract preparation

The extract was prepared using chloroform. In a clean and dried conical flask, 1kg of dried algae was taken, in that chloroform was added and closed tightly and kept in a room temperature for 24 hrs. The solvent was filtered and evaporated. The weight of the extract was weighed and the carbohydrate, lipid and protein content were quantified separately.

Effect of pH on algal growth [10] [11]

Some algae can tolerate high pH and some cannot, the effect of pH on growth and lipid content has to be assessed for selection of suitable strains for biofuel production. The effect of pH on growth of the algae and hydrocarbon yields can be studied using BG-11 media with different pH levels *viz* 6,7 and 9. 100ml of BG-11 media was prepared in 250ml conical flask and pH was adjusted before autoclaving. The flask was inoculated uniformly at 25% (v/v) innoculum of 2 weeks old algal culture. The cultures were incubated for 3 weeks at 25±1 ^{o} C and the OD values were recorded at 680 nm in a spectrophotometer at 24 hrs interval. A graph was plotted in a graph against time and growth culture. Influence of pH on

Extraction of algal oil
Oil extraction

Algae were ground with motor and pestle as much as possible. The ground algae were dried for 20 min at 80°C in a incubator for releasing water. Hexane and ether solution (20 and 20 mL) were mixed with the dried ground algae to extract oil. Then the mixture was kept for 24 h for settling.

Biomass collection

The biomass was collected after filtration and weighted.

Evaporation

The extracted oil was evaporated in vaccum to release hexane and ether solutions using rotary evaporator.

Transesterification

The reaction process is called transesterification. The conical flask containing solution was shaken for 3 h by electric shaker at 300rpm.The transesterification reaction was carried out in a 500 ml glass made batch reactor, equipped with a thermometer, condenser and magnetic stirring systems. The reactor containing of 50 g bitter almond oil was placed in a water bath heated by a hot plate. The BAO was agitated and heated up to an appropriate temperature. A defined amount of catalyst previously dissolved in methanol was added to the BAO, the reaction started and continued for 60 min.After the reaction ended, heating and stirring were stopped and the reaction mixture was transferred into a decanter and left for1 h to separate two distinct phases, i.e. ester phase (biodiesel) and glycerol phase. It took approximately 10 min to conduct this phase separation, but the biodiesel layer was translucent. After1 h, the ester phase became transparent and the separation was completed. Further reaction may happen during the settling time, but the process is slow because of a low temperature, lack of stirring and presence of low amounts of catalyst and methanol. However, it is said that even longer settling time is favourable for the separation [13], [14]. The glycerol phase formed in the lower layer, was decanted. The ester phase (biodiesel) was washed with 35 ml of hot distilled water, then with 35 ml of hydrochloric acid 0.5% to neutralize the remaining catalyst and to decompose the soaps formed during the transesterification reaction. Finally, it was washed with 35 ml of hot distilled water three times. The successive rinses removed impurities such as the residual catalyst, methanol, glycerol and soaps. The ester phase was then dried using manganese sulfate and filtered under vacuum conditions to eliminate manganese sulfate crystals. The final product was weighed for determination of product yield and then analyzed by GC to calculate biodiesel purity.

Characterization of the oil

The extracted material was analyzed quantitatively by GC and qualitatively by GC-MS. The identification of the species extracted was carried out comparing the relevant retention time and the mass fragmentation with that of pure species used as standards. As internal standard methyl eptanoate was used. Analyses were done in duplicate and data are reported as means of three measurements. List of components present studied by GC MS for fungal sp and algal sp are shown in the table and respectively and chromatogram shown in fig and. Composition of Fatty acids in algae and fungal sp and were analyzed through GC-MS.The data obtained from influence of nations and cultural conditions on lipid production were analyzed as factorial experiment in Completely Randomized Design (Anderson and Mclean, 1974).

RESULTS AND DISCUSSION

Out of three isolates tested, SP sample shows high lipid production and biomass (23.80 % and 10.12 g/l)) .So the SP sample was selected for further studies (Fig.1).

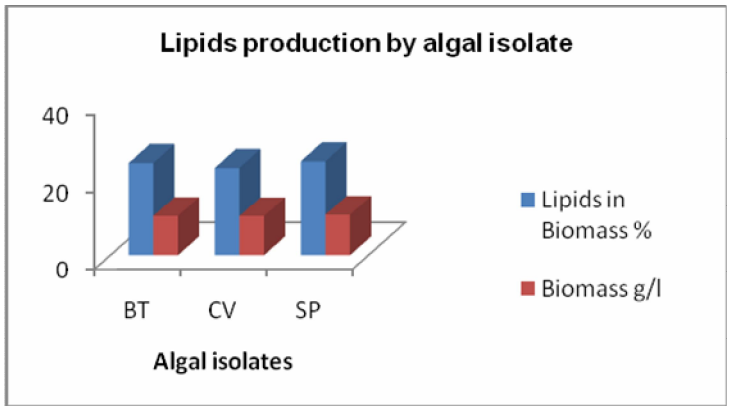

Fig.1 Lipid production by algal isolates.

Influence of different light intensity on the lipid products by algal isolate (SP) under invitro condition [15]

In order to find out the optimum light intensity for maximum lipid production, light intensity (LUX) ranging from 500 LUX to 1000 LUX were evaluated. Maximum lipid production (42%) was observed significantly at 1000 LUX light intensity, and there after lipid accumulation decreased in the below LUX of 500 – 900 LUX. Biomass formation also observed the same trend (FIG 2)

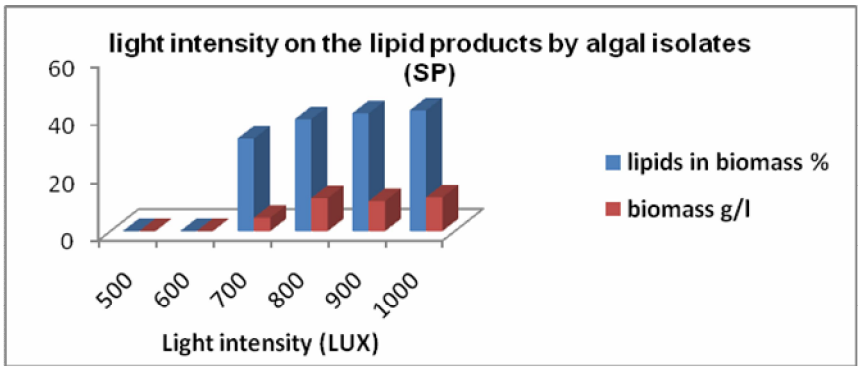

Fig 2 Influence of different light intensity on the lipid products by algal isolate (SP) under invitro condition

Influence of nitrogen source on lipids production by algal isolate (SP) [16]

Lipids and biomass production was determined by growing algal isolate at different nitrogen sources at 0.5 M concentration. Among the three nitrogen sources tested sodium nitrate produced significant amount of lipids (23.80%) followed by potassium nitrate (22.54%), the least amount of lipids (22.23%) accumulation was observed when ammonium chloride incorporated in to the medium (Fig 3).

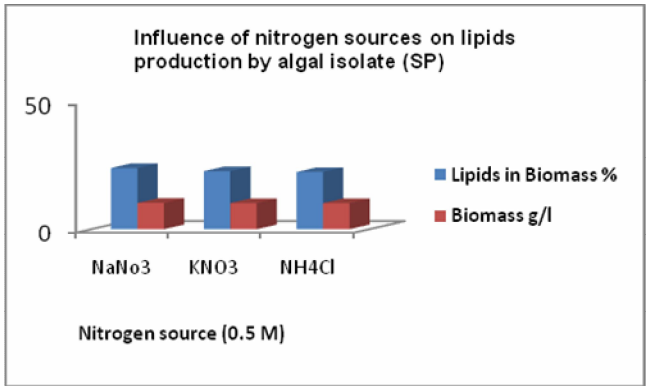

Fig 3 Influence of nitrogen sources on lipids production by algal isolate (SP)

Influence of temperature on lipids production by algal isolate (SP) [17]

In order to optimize the temperature for maximum lipids production by algal isolate (SP), the algae was grown at different temperature ranges from 20/ 25, 30, 35 and 40°C. The algal sample SP showed significantly more lipids (41.92 %) at 30°C and least amount of lipids (20.65%) was recorded at 20° C (Fig 4).

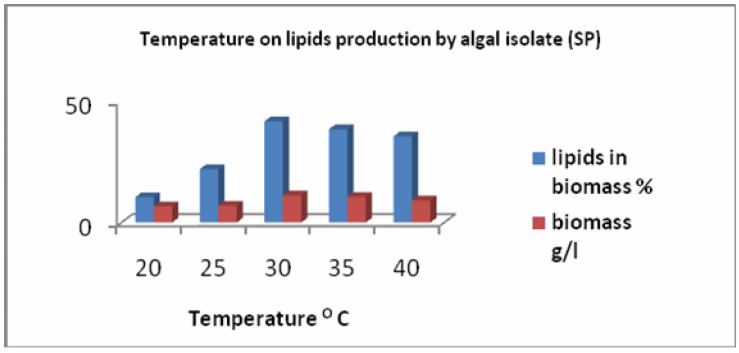

Fig 4 Temperature on lipids production by algal isolate (SP)

Influence of different pH on lipids production by algal isolate (SP) [18] [19]

The influence of pH by algal isolate (SP) was investigated at different pH ranged from 6, 6.5, 7, 7.5 and 8 on lipids production. Maximum lipids (42.70%) and biomass (11.60g/l) content was obtained significantly when the algal growth at a pH of 7. It is observed that the least amount of lipids (33.36%) and biomass (10.31g/l) content was recorded at pH 6.0 and no growth and lipids accumulation was observed at pH of 8 (Fig 4)

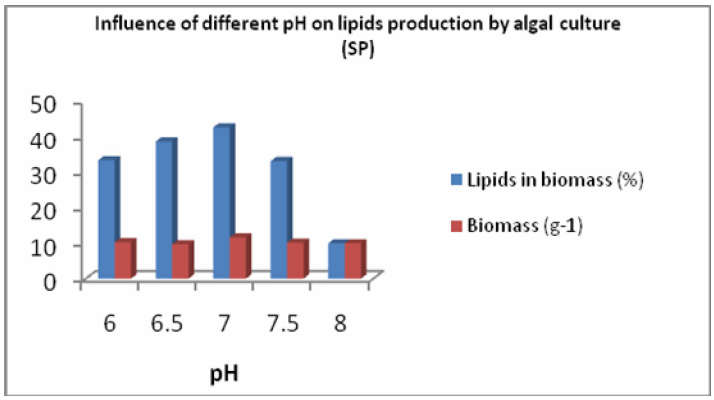

Fig 5 Influence of different pH on lipids production by algal culture (SP)

Physico – chemical properties of algal lipids (SP)

Lipids produced through bioreactor was analysed for its physico - chemical properties in order to use as biodiesel, values were furnished in the (Table 1). The obtained values were compared with ASTM standards. The physical properties like, specific gravity of 0.95 g/cc, viscosity at 40^{o}C of 53.96cSt, calorific value of 32.05 Kcal/kg, Flash 219^{o}C, Fire point 230^{o}C,Cloud point 4^{o}C, Pour point 6^{o}C and the chemical properties of lipids like Free fatty acids (FFA) of 15% and Acid value 25.04were obtained. Viscosity of algal lipids (53.96 cST) and acid value (26.03) were higher when compared to the standard (1.9-6.0 cSt and <08) respectively. Whereas other properties like flash point, carbon residue were within the limit of the standard. Fatty acids profiles oleic acid (20.43 min), galactofuranose (15.46) and D-Allose (13.32) were identified based on their retention times.

CONCLUSION

The present study reveals that the biodiesel produced from algae is very economical and eco-friendly because of the less amount of carbon content. The values of the algal isolate are higher than the standard level, which causes engine blockage and it needs to be reduced through transesterification. From the present study, it was concluded that in order to use the algal lipids as such for biodiesel, it has to undergo the process like transesterification to meet out the standard levels of ASTM (American society for testing and materials) D6751 specification.

ACKNOWLEDGEMENT

I wish to express my sense of gratitude and sincere thanks to my beloved guide, my beloved friends and my beloved parents and Almighty to those who have helped immensely in the successful completion of my research work.

Table.1 Physico – chemical properties of algal lipids (SP)

Property	Unit	Algal oil	Biodiesel standards	
			ASTM D 6751-02	DIN EN 14214
Specific gravity	g/cc	0.95	-	-
Viscosity @ 40°C	cSt	53.96	1.9-6.0	3.5-5.0
Calorific value	Kcal/kg	33.05	-	-
Carbon residue	%	0.093	-	<0.3
Ash content	%	0.69	<0.02	<0.02
Flash point	° C	219	>130	>120
Fire point	° C	230	-	-
Cloud point	° C	3	-	-
Pore point	° C	6	-	-
FFA	%	15.0	-	-
Acid value		26.03	<0.8	<0.5

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SCHEME FOR YOUNG SCIENTISTS

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2. The funding is upto a maximum of Rs.23.00 lakhs (excluding overheads) for a period not exceeding three years.
3. All care must be taken to write a good scientific proposal (A copy of the **model proposal** is put on the website for reference). The proposal should contain significant novelty and should lead to enrichment of scientific knowledge in the field. Routine extension of Ph.D or any other work will be discouraged. The candidates who are unemployed and drawing fellowship from the project are encouraged to choose the place of work different from the place where they have completed their Ph.D or other degree obtained in the immediate past.
4. Projects which involve Recombinant DNA work should be examined and certified by Institutional Biosafety Committee.
5. Projects, which are clinically oriented or projects, which involve experiments with human and/or animal material, should be examined and certified by Institutional Ethics Committee.
6. All the required information should be given in the text of the proposal itself and not as annexures.
7. Incomplete application and application lacking scientific/technical details will not be considered.
8. At the time of submission of proposals, it is not necessary to get it forwarded by any Institute/ Laboratory.
9. Ten (10) copies of the proposal, in the format given below, neatly typed on both sides of A-4 size paper, should be submitted to the concerned officer in DST at any time during the year at the following address

Conecerned officer's Name & Designation
Department of Science & Technology
Technology Bhavan, New Mehrauli Road
New Delhi-110016
Telefax: 011-26963695
Email: venktesh@nic.in
Website: www.serc-dst.org

10 A soft copy of the proposal may also be sent along with the hard copies/ or email the same to the concerned officer's email address.

11. The envelope containing the proposal should be superscribed with "Fast Track Proposals for Young Scientists - (mention broad subject area)."10.

12. For dispatch of proposals and for further information follwing is the list of Concerned officer.

SCHEME FOR YOUNG SCIENTISTS

Contact persons

Subject Area	Name	Email Address	Telephone
Physical Science & Mathematical Science	Dr R Brakaspathy Scientist G Shri Praveen Kumar S Scientist C	rbpathy @ nic.in praveen @ nic.in	26590270 26590353
Life Science	Shri Rambir Singh Scientist F Shri Sunit Minz Junior Analyst	rambir@ yahoo.com sunit@nic.in	26590332 26590330
Chemical Science	Dr. R. Brakaspathy Scientist G Shri R.K. Joshi Scientist C	rbpathy@nic.in rkjoshi@nic.in	26522815 26590348
Earth and Atmospheric Science	Dr R Brakaspathy Scientist G Dr Umesh Kumar Sharma Scientist C	rbpathy @ nic.in uk.sharma@nic.in	26590270 26590680
Engineering Science	Shri Milind Kulkarni Scientist E	milind@nic.in	26590478

SCHEME FOR YOUNG SCIENTISTS

Application Format

1. Broad subject area (Life Sciences, Physical Sciences, Chemical Sciences, Earth & Atmospheric Sciences, Mathematical Sciences, Engineering Sciences):
2. Specialization :
3. Title of the proposed project:
4. Name and address of the Investigator:
   (including Tel.No., Fax, Email, etc.)
5. Details of the proposed project to be undertaken:
   - Origin of proposal
   - Research work engaged in at present
   - Objectives of the proposed project
   - Review of R&D in the proposed area (National & International Status, Importance, patents etc.)
   - Work plan (including *detailed methodology* and time schedule)
   - Future plans
   - Details of the research funding received in the past and/ongoing projects (mention Ref. no., title, duration, cost, funding agency, and brief achievements).
6. Name and address of the institution where the proposal will be/likely to be executed:
7. Facilities provided/to be made available at the host institute:
8. Name(s) and address(es) of Indian expert(s) in the proposed area:
9. Details of financial requirements for three years (**with justifications**) and phasing for each year:

S.No.	Head	1st Year	2nd Year	3rd Year	Total
1.	Fellowship @Rs.35,000/-p.m.*				
2.	Manpower**				
3.	Consumables				
4.	Travel (within India)				
5.	Contingency				
6.	Equipment (Generic Name with minimum required accessories, make & model & Cost in Indian Rupees)				
7.	Overhead Costs (max. up to 20% of project cost)				

* applicable to scientist having no regular employment and are not drawing any fellowship during the project tenure

** applicable for researcher holding regular position.

10. Have you ever applied before under this Scheme or Women Scientist Scheme? If yes, give details (Name of the scheme, Title, subject area, reference number, if any, year and the decision).
11. Any other information in support of the proposed project:
12. Statement from the Present Employer as per Annexure-I (In respect of person holding regular position).

SCHEME FOR YOUNG SCIENTISTS

Detailed Biodata

1. Name of the Applicant:
2. Mailing Address (Indicate Telephone, Fax, E-mail, etc.)
3. Date of Birth & Gender:
4. Educational Qualifications (Starting from Graduation onwards):
5.
   - Details of professional training and research experience, specifying period.
   - Details of employment (past & present).
   - List of publications during last five years (with complete details such as Journal name, all the author's name as appeared in the journal, volume number, page number and the year of publication).
6. Professional recognition, awards, fellowships received:
7. Any other information.

Place & date: Signature of the applicant

Annexure-I

(Statement from Employer, if employed)

This is to certify that:

I. Dr. _____, the Principal Investigator in the project entitled……will assume full responsibility for implementing the project.
II. The date of appointment starts from the date on which the University/Institute receives the bank draft/cheque from the Department of Science & Technology.
III. The Investigator will be governed by the rules and regulations of the University/ Institute and will be under administrative control of the University/ Institute for the duration of the project.
IV. The grant-in-aid by the Department of Science & Technology will be used to meet the expenditure on the project and for the period for which the project has been sanctioned as indicated in the sanction letter/ order.
V. No administrative or other liability will be attached to the Department of Science & Technology at the end of the project.
VI. The University/ Institute will provide basic infrastructure and other required facilities to the investigator for undertaking the research project.
VII. The University/ Institute will take into its books all assets received under this sanction and its disposal would be at the discretion of Department of Science & Technology.
VIII. Institute assumes to undertake the financial and other management responsibilities of the project.

Seal of University/Institute Signature

Registrar of University/Head of Institute

Source : DST/Govt.,of India