

Analysis of Subcellular Localization Sites and Calculation of Isotopic Mass for *Catharanthus roseus* L.

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ABSTRACT

The aim of the study is to investigate the sub cellular localization sites for *Catharanthus roseus* and calculate the isotopic mass value for the elements present in the sample. The Plant sequence was retrieved and the localization sites were predicted by using PSORT tool. It shows Chloroplast thylakoid Membrane has the highest value of 0.780. Isotopic mass was calculated for the elements present in the sample and it shows the carbon has the mass of 36536.549. From these results, it could be possible to understand the activity of the plant and we suggest that this plant may address the problem of cancer and act as an antitumour agent.

Key words: Sub cellular Localization sites, *Catharanthus roseus*, Isotopic Mass value, Elements, Antitumour agent, Chloroplast thylakoid.

INTRODUCTION

In the last century, the compounds derived from the plants and utilized for ornamental purpose and in the preparation of medicines. Nowadays, *Catharanthus roseus* L. is a popular and familiar plant and it has sumptuous medicinal activity. It belongs to the family *Apocynaceae*. Self compatibility and a relatively high tolerance of disturbance have enabled this species to spread from cultivation and naturalise in many parts of the world. As a consequence, this species is sometimes considered to be an invasive weed, although it does not normally proliferate sufficiently to eliminate native vegetation [1]. The researchers found that the *Catharanthus roseus* have anti-diabetic properties due to the presence of several highly toxic alkaloids present in it. These alkaloids are used in the treatment of different types of cancer with one derived compound vincristine. The alkaloid Alstonine which has been used to reduce blood pressure. The anti cancer drug namely Vincristine and Vinblastine are produced from *Catharanthus roseus* and it has number of Pharmaceutical Activities [2].

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Anti cancer drug Vinblastine and vincristine are alkaloids found in *Catharanthus roseus*. They are administered intravenously and these solutions are fatal if they are administered any other way and can cause a lot of tissue irritation if they leak out of the vein. Although these compounds are very similar in structure and have the same basic action and they have distinctly different effects on the body [3]. Plant and phytochemical products continue to play an important role in medicine. The toxicological potentials of the aqueous leaf extract of *Catharanthus roseus* was used to treat cancer [4]. *Catharanthus roseus* produces phenols, chemicals to protect itself but recent research demonstrate that many phytochemicals can protect humans against diseases [5].

In *Catharanthus roseus* is known to produce a distinct spectrum of terpenoid indole alkaloids. Since the invaluable anti neoplastic bis indole alkaloids are restricted to the aerial parts of the plant and do not occur in its underground tissues, identification of the structural and regulatory factors operating distinctly in the shoot and leaf of the plant [6]. *Catharanthus roseus* is very important and different parts of the plant used in the treatments of various diseases in many numbers of countries. Moreover, more than 130 alkaloids have been isolated from different parts in which two important alkaloids Vinblastine and Vincristine are used in cancer treatment present in very low concentrations. Thus, in present communication various in vitro biotechnological and biochemical approaches have been used all over the world [7]. The preliminary cytotoxicity study demonstrated does independent cytotoxic activity of methanol extract of *Catharanthus roseus* when screened (HCT116) colorectal carcinoma cell line. N-hexane, chloroform and methanol fractions showed does independent cytotoxic activity with chloroform fractions showing the highest activity [8]. The antibacterial and antidiabetic activities of whole plant extract of *Catharanthus roseus* has been evaluated by the researchers [9]. The Exhibition of antioxidant and anti mutation that suggested the chemo preventive potential against various cancers including breast cancer. This research was conducted to investigate anticancer activity of *Catharanthus roseus* [10].

MATERIALS AND METHODS

The *Catharanthus roseus* sequence was collected from the database and submitted to PSORT tool for the analysis of Sub Cellular Localization Sites. The Localization sites were predicted and the values were retrieved for the regions. The sequence was also subjected to Isotopident tool for the calculation of isotopic mass. The mass values were calculated for the elements such as Carbon, Hydrogen, Oxygen, Nitrogen and Sulphur. Finally, the values were compared and discussed.

RESULTS AND DISCUSSION

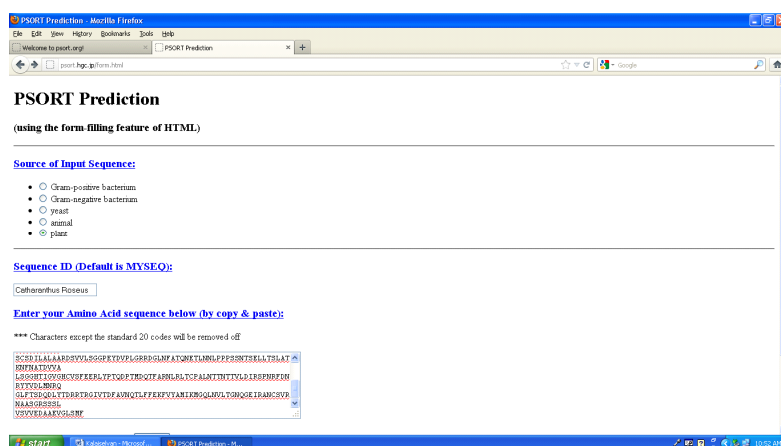


Fig 1: Submission of the plant sequence to the PSORT tool

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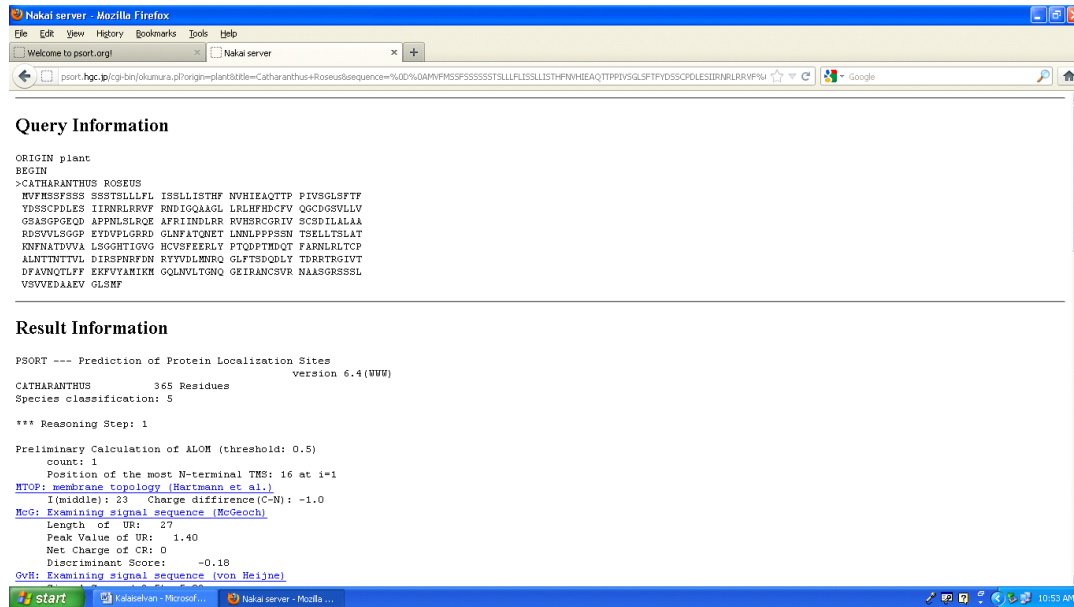


Fig 2: Prediction of Sub cellular Localization

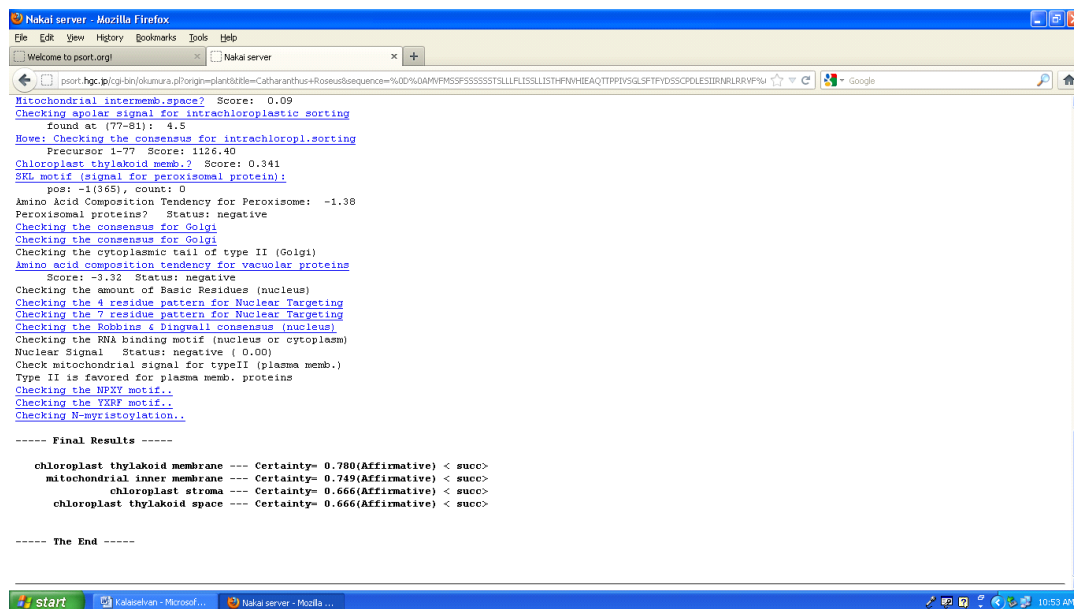


Fig 3: Composition of Sub cellular Localization

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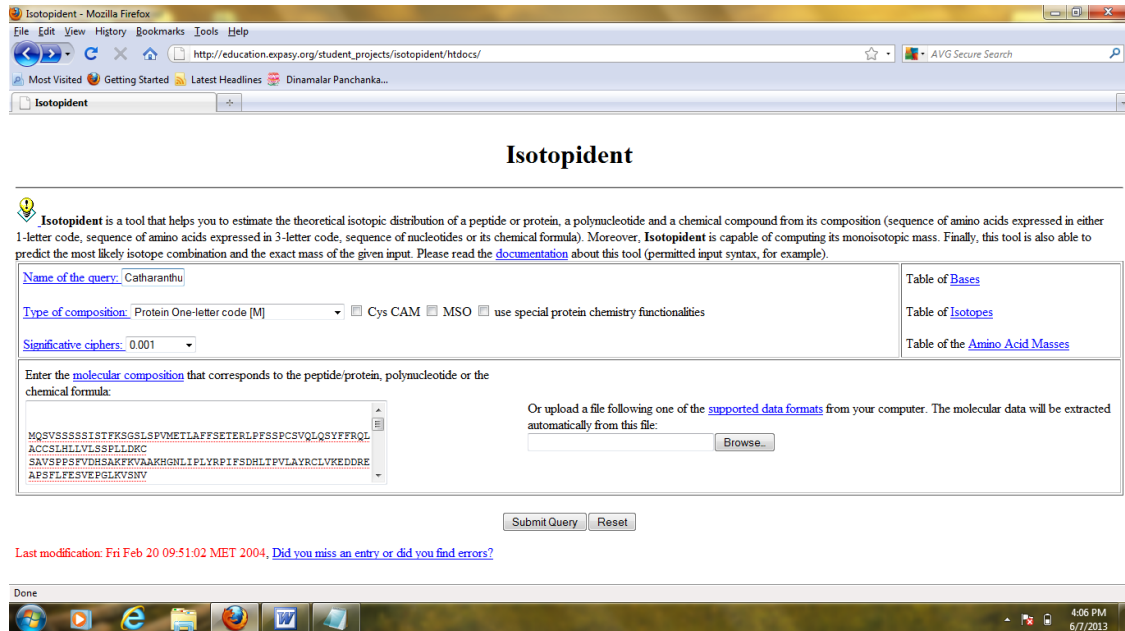


Fig 4: Submission of plant sequence to Isotopident tool

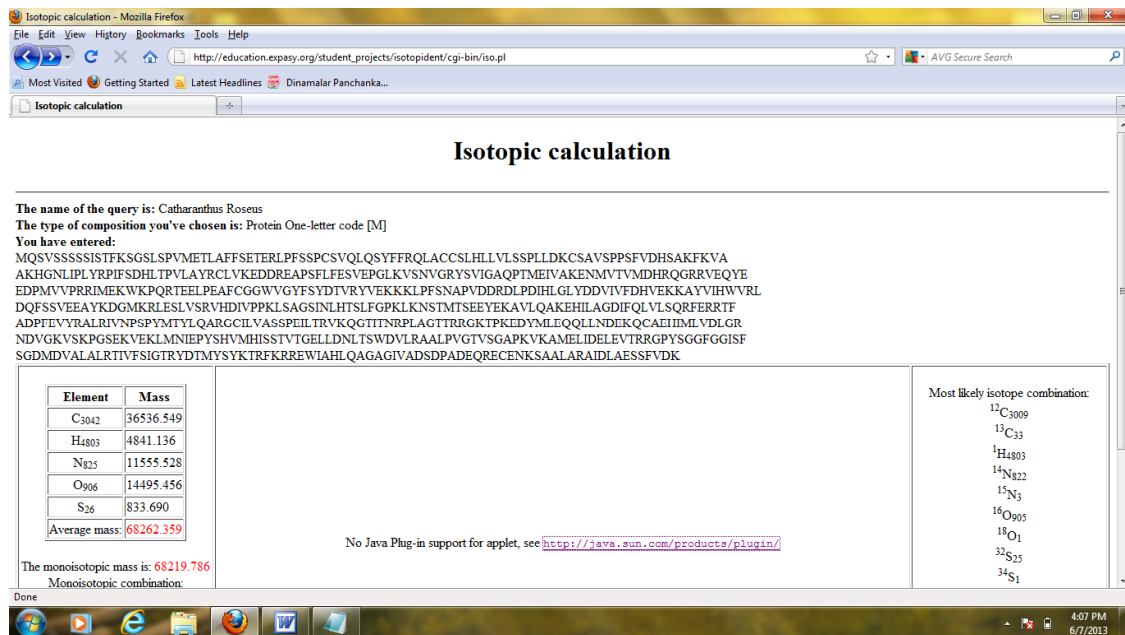


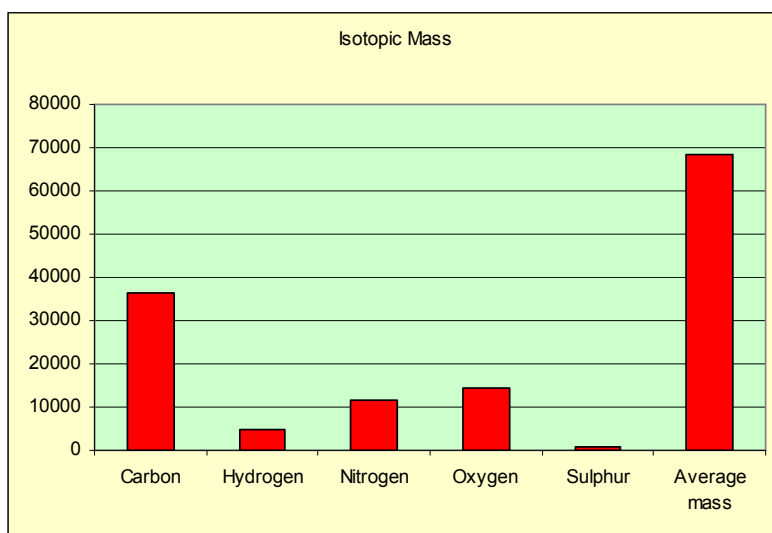
Fig 5: Calculation of Isotopic mass for the sequence

Table 1: Analysis of Sub Cellular Localization

S.No.	Sub Cellular Localization	Composition
1	Chloroplasts Thylakoid Membrane	0.780
2	Mitochondrial Inner Membrane	0.749
3	Chloroplasts Stroma	0.666
4	Chloroplasts Thylakoid Space	0.666

Table 2: Composition of Isotopic mass for the elements

Element	Mass
C ₃₀₄₂	36536.549
H ₄₈₀₃	4841.136
N ₈₂₅	11555.528
O ₉₀₆	14495.456
S ₂₆	833.690
Average mass	68262.359



Graph 1: Composition of Isotopic masses

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The *Catharanthus roseus* sequence was collected from the database and submitted to PSORT tool for the analysis of Sub Cellular Localization Sites (Fig 1). The sub cellular localization regions were predicted and displayed in Fig 2. In Fig 3, the composition of regions in the sites was derived from the tool. The Regions were Chloroplasts thylakoid Membrane, Mitochondrial inner Membrane, Chloroplasts Stroma and Chloroplasts thylakoid space. The Composition values for these regions showed as 0.780 and 0.749 for Chloroplasts thylakoid Membrane and Mitochondrial inner Membrane respectively. The values 0.666 and 0.666 for Chloroplasts Stroma and Chloroplasts Thylakoid space. The Sequence was also submitted to Isotopident tool for the Calculation of mass value (Fig 4). The atom Carbon, Hydrogen, Oxygen, Nitrogen and Sulphur plays a major role in the functioning of biomolecules. Fig 5 shows that the isotopic calculation of mass for these atoms. It shows the value for Carbon is 36536.549 and 4841.136 for Hydrogen. The values 11555.528, 14495.456 and 833.690 for Oxygen, Nitrogen and Sulphur respectively. The element Carbon has the highest mass value while Sulphur is very less. The element Oxygen and Nitrogen has a moderate value while hydrogen is less when compared with these elements. The average mass value for the above elements is that 68262.359 is showed in Table 2. Graph 1 show that the comparison of mass value and graphical representation of elements based on the values.

CONCLUSION

The *Catharanthus roseus* sequence was retrieved from database and the sub cellular localization sites were identified. The Plant sequence which shows Chloroplast thylakoid membrane has the highest value of 0.780. It plays a significant role in all the biological functions. The sequence was also subjected to isotopic mass calculation and the mass value for the elements was calculated. From these observations, we found that the atom carbon has the highest mass value which is present in the *Catharanthus roseus* sample.

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Seasonal Variation of Physico- Chemical Parameters in Gundur Lake.

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ABSTRACT

For assessing the seasonal fluctuation of lake water quality with respect to urbanization physico-chemical characteristics of Gundur lake water and sediment sample was analyzed and Water Quality Index was computed to evaluate the level of pollution. During summer pH, EC, salinity, chloride, hardness, Total Alkalinity, BOD,COD, Nitrate, Sulphate, Sodium and Potassium values of water sample and sodium level in sediment sample were recorded to be higher than rainy season. Temperature, TDS, DO, DO saturation Index and phosphate of water sample and pH, EC, ORP, TOC, Available phosphate, Potassium, calcium, magnesium and sodium of sediment sample were recorded to be higher in rainy season. Results indicated that the sampling site S11 was found to be severely polluted. WQI level shows in summer the lake was highly polluted than in rainy season.

Key words: Gundur lake, Seasonal variation, Sediment, Water Quality Index.

INTRODUCTION

Lake water is an essential renewable resource for mankind and the environment. It is important for civil (drinking water supply, irrigation, transportation), industrial (processing and cooling, energy production, fishery), recreational purposes, appreciated for their water resources, ground water recharges and habitats of a wide variety of fauna and flora [1, 2]. Lake ecosystems tend to maintain a state of equilibrium but their chemical resilience depends on certain site-specific factors and processes [3]. But it has been recognized that the anthropogenic impact on natural environments, especially on aquatic ecosystems is currently a topic of increasing concern. The myriad ways in which humans use lakes, along with numerous pollutant generating activities of society, have stressed lake ecosystems in diverse ways, frequently causing impairment of lake quality for other uses [4]. Deterioration of surface water and Lake water quality has recently observed in many aquatories. The potential causes of such a situation are various point source pollution (domestic and industrial effluents) can be localized and well-established, whereas the

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influence of non-point pollution (runoff from intensively cultivated areas and urban centres) is less obvious because of the inadequately defined direction and frequency of non-point source loading. Most of those activities lead to the pollution of lakes. The quality of lake water may vary depending on the geological morphology, vegetation and activities in the catchment basin, as well as on the location of the sampling site [5, 6, 7]. Various authors [8, 9, 10] have analyzed physicochemical and biological characteristics of surface water bodies in the Tiruchirappalli region. However, only few studies have been investigated the physico-chemical characteristics of Gundur Lake. This investigation was carried to quantify the impact of rapid urbanization in Gundur lake. The goal of this paper is to quantify the role of anthropogenic activity on physico chemical nature of Gundur Lake with respect to seasonal variation. Such an assessment is important and urgent for defining potential management options and for making optimal use of the limited financial resources to protect the lake.

Study Area

Gundur Lake is located in southern part of the Tiruchirappalli, 10 Km from the City. The geographic coordination of its water area is Lat 10°44 N, Long 78°43'E. The pond is fed by a canal branching out from new kattalai high level channel of river Kavery. Northern and eastern sides of the lake are covered by human habitation and agricultural. The western and Southern flanks are covered by human habitation. The lake gets flooded only during monsoons. Rest of the days it is almost dry. The lake and their wetlands support a large number of plants, shown in figure 1.

MATERIALS AND METHODS

For the present study water and sediment samples were collected at twelve different sites (S1 to S12) in Gundur Lake. The sampling program was carried out during rainy and summer. All samples were packed into airtight plastic bags, stored in the dark at 4°C and immediately transferred to the laboratory for analysis. Temperature water and sediment sample were recorded in situ. The water samples were analyzed for the physico-chemical parameters namely pH, Electrical Conductivity (EC), Total dissolved solids (TDS), Salinity, chloride, total hardness, Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), phosphate, nitrate, sulphate, sodium, potassium, Dissolved Oxygen (DO), following standard methods (APHA,1998)[11]. The sediment samples were analyzed for the physico-chemical analysis like pH, EC (Electrical conductivity), ORP (Oxidation Reduction Potential), Total organic Carbon (TOC), Phosphate, sodium, Potassium, Calcium, Magnesium, Sodium Adsorption Ratio (SAR). In addition Water Quality Index (WQI) of the samples was calculated by the method described by Srivastava and Kumar, 2013[12]. Results obtained were subjected to statistical analysis using PAST.

RESULTS

The summary statistics of water and sediment samples were presented in table 1.

Temperature

In summer, temperature level was ranged from 28.00 to 30.00 °C and had a mean value of 29.67 °C, minimum value was recorded in sampling site 6(S6), maximum value was recorded in sampling site 2 (S2). During rainy, temperature level was ranged from 27.00 to 30.00°C, had mean value 28.67°C, minimum value was recorded in sampling site 5 (S5), maximum value was recorded in sampling site 7 (S7).

pH

During summer, the pH value ranged from 8.22 to 9.84 and had a mean value of 9.09, minimum value was observed in sample site 6 (S6), maximum value 9.84 was recorded in sampling site 2 (S2). In rainy season ranged from 7.96 to

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8.84 had a mean value of 8.30, minimum value was observed in sampling site 11 (S11), maximum value was recorded in sampling site 2 (S2). Alkaline state of pH might be due to the chemical buffering and release of bicarbonate and carbonate ions or salts [13]. Higher level of pH in summer may be due to high decomposition activities [14, 15].

Electrical Conductivity

The Electrical conductivity summer value ranged from 1.15 to 2.34 mS/cm, had a mean value of 1.55 mS/cm, minimum value was observed in sample site 5 (S5), maximum value was recorded in sampling site 11 (S11). In rainy season, EC ranged from 0.896 to 1.55 mS/cm and had a mean value of 2.22 mS/cm, minimum value was observed in sampling site 2 (S2), maximum value was recorded in sampling site 11 (S11). Conductivity of water depends upon the concentration of ions and its nutrient status and variation in dissolve solid content. Seasonal variation in the conductivity is mostly due to increased concentration of salt because of evaporation [16].

Total Dissolved Solids (TDS)

During summer, the TDS value ranged from 320.00 to 840.00 mg/l and had a mean value of 502.75 mg/l, minimum value was observed in sample site 3 (S3), maximum value was recorded in sampling site 11 (S11). In rainy season, TDS value ranged from 467.00 to 1170.00 mg/l had a mean value of 618.25 mg/l, minimum value was observed in sampling site 3 (S3), maximum value was recorded in sampling site 11(S11). When compare the levels of TDS summer had lower level than rainy season due to contamination of domestic waste water, garbage, fertilizer, etc in the natural surface water body the value of TDS was reported to be high [17].

Salinity

Salinity value ranged from 580.00 to 1520.00 mg/l and had a mean value of 797.50 mg/l in summer, minimum value was recorded in sampling site 2 (S2), maximum value was recorded in sampling site 11(S11). In rainy season, salinity value ranged from 560 to 1390 mg/l and had a mean value of 740.83 mg/l, minimum value was recorded in sampling site 2 (S2), maximum value was recorded in sampling site 11 (S11).

Chloride

During summer, chloride value ranged from 120.53 to 292.33 mg/l and had a mean value of 183.30 mg/l, minimum value was recorded in sampling site 4 (S4), maximum value was recorded in sampling site 10 (S10). In rainy season, chloride value ranged from 92.17 to 276.51 mg/l and had a mean value of 158.40 mg/l, minimum value recorded in sample site 3 (S3), maximum value was recorded in sample site 11 (S11). When compare the levels of chloride summer has higher level than rainy season. The greater source of chlorides in lake water is disposal of sewage and industrial waste [18].

Total hardness

Total hardness value ranged from 180.00 to 490.00 mg/l and had a mean value of which is 252.50 mg/l in summer, minimum value was recorded in sampling site 5 (S5), maximum value was recorded in sampling site 11(S11). In rainy season, hardness value ranged from 130 to 252.50 mg/l, minimum value was recorded in sampling site 5 (S5), maximum value was recorded in sampling site 11 (S11). Lake hardness and alkalinity are affected by the type of minerals in the soil and watershed bedrock, and by the amount of lake water coming into contact with these minerals. If a lake gets ground water from aquifers containing limestone minerals such as calcite (CaCO_3) and dolomite (CaMgCO_3), hardness and alkalinity shall be high[19].

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During summer, alkalinity value ranged from 160.00 to 250.00 mg/l and had a mean value of 189.17 mg/l, minimum value was recorded in sample site 1(S1), maximum value was recorded in sampling site 2 (S2). The rainy season, alkalinity value ranged from 112 to 210.00 mg/l and had a mean value 168.50 mg/l, minimum value was observed in sampling site 9 (S9), maximum value was recorded in sampling site 6 (S6). A lake water alkalinity may results due to waste discharge, microbial decomposition of organic matter in the water body [20].

Dissolved Oxygen (DO) and DO saturation Index

Dissolved Oxygen value ranged from 4.2 to 5.9 mg/l and had a mean value of 5.27 mg/l in summer, minimum value was observed in sampling site 11 (S11), maximum value was recorded in sampling site 10 (S10). In rainy season, DO value ranged from 5.60 to 6.40 mg/l and had a mean value 5.63 minimum value was observed in sampling site 6 (S6), maximum value was recorded in sample site (S1, S7 and S11). When compare the levels of DO summer has lower level than rainy season may be due organic pollution and inorganic reductants substances.

During summer, DO saturation level index 60 to 80.00 and had a mean value of 68.75, minimum value was observed in sampling site 11(S11), maximum value was recorded in sampling site 10 (S10). In rainy season, DO saturation index value ranged from 60 to 80 and had a mean value of 71.67, minimum value was recorded in sampling site 5 (S5), maximum value was observed in sampling site 1, 7 and 11(S1, S7 and S11).

Biological Oxygen Demand (BOD)

Biological Oxygen Demand (BOD) summer value ranged from 56.40 to 132.50 mg/l and had a mean value of 81.24 mg/l, minimum value was observed in sampling site 5 (S5), maximum value was recorded in sample site 11 (S11). In rainy season, BOD value ranged from 31.25 to 125.00 mg/l, minimum the value was observed in sampling site 7, 9, 10 and 12 (S7,S9,S10 and S12), maximum value was recorded in sampling site 11 (S11). When compare the level of BOD summer has higher level than rainy season due increase with increase in the amount of ready metabolic organics present in the water [21].

Chemical Oxygen Demand (COD)

During summer Chemical Oxygen Demand (COD) value ranged from 155.6 to 420.00 mg/l and had a mean value of 192.88 mg/l, minimum value was recorded in sampling site 5 (S5), maximum value was observed in sampling site 11 (S11). In rainy season, COD value ranged from 132.00 to 375.00 mg/l and had a mean value 169.31 mg/l, minimum the value was observed in sampling site 5 (S5), maximum value was recorded in sampling site 11 (S11). COD indicates the oxidisable organic matter load [21].

Phosphate

Phosphate level in summer value ranged from 5.00 to 10.50 mg/l and had a mean value of 7.54 mg/l, minimum value was observed in sampling site 7 (S7), maximum value was recorded in sampling site 10 (S10). In rainy season, phosphate value ranged from 10.00 to 38.00 and had a mean 23.23 mg/l, minimum value in sampling site 8 (S8), maximum value 38.00 mg/l in sampling site 11 (S11). Phosphate content in a lake may be due to release of phosphate from bottom sediment organic load of the water and also by human activities [22].

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During summer, nitrate value ranged from 8.33 to 46.51 mg/l and had a mean value of 28.63 mg/l, minimum value was recorded in sampling site 4 (S₄), maximum value was observed in sampling site 1 (S₁₁). In rainy season, nitrate value ranged from 4.00 to 21.00 and had a mean value 12.83 mg/l minimum the value was recorded in sampling site 4 (S₄), maximum value was recorded in sampling site 11 (S₁₁). The higher level of nitrate may be due to leaching losses from soil organic matter, leaching of fertilizers applied to soil, leachates from refuse dumps and industrial discharge also contribute to presence of nitrates [23].

Sulphate

In summer, sulphate value ranged from 7.50 to 20.50 mg/l and had a mean value of 10.21 mg/l, minimum value was observed in sampling site 8 (S₈), maximum value was recorded in sampling site 11 (S₁₁). In rainy season, sulphate value ranged from 5.00 to 18.50 mg/l and had a mean value of 7.32 mg/l, maximum value was recorded in sampling site 11 (S₁₁), minimum value in sampling site 1 (S₁). Sulphate in lake water is primarily related to the types of minerals found in the watershed and acid rain [19].

Sodium

During summer, sodium value ranged from 125.8 to 180.50 mg/l and had a mean value of 145.00 mg/l, minimum value was recorded in sampling site 1 (S₁), maximum value was observed in sampling site 12 (S₁₂). In rainy season, sodium value ranged from 105.30 to 160.90 mg/l and had a mean value 124.55 mg/l, minimum value was observed in sampling site 2 (S₂), maximum value was recorded in sampling site 12 (S₁₂). Sodium cations largely make way into water medium through weather of rocks. High sodium content makes water salty and unfit for consumption [23].

Potassium

In summer, potassium value ranged from 90.50 to 230.40 mg/l and had a mean value 128.59 mg/l, minimum value was observed in sampling site 10 (S₁₀), maximum value was recorded in sampling site 7 (S₇). In rainy season, potassium value ranged from 85.30 to 216.2 mg/l and had a mean 89.30 mg/l, minimum value was recorded in sampling site 4 (S₄), maximum value was recorded in sampling site 11 (S₁₁).

Water Quality Index

The water quality index for the water sample collected in summer and rainy was computed to be 17.08 and 41.27 when compared the WQI, summer level was recorded to more severe than rainy season which may be due to the anthropogenic activities such as bathing, cleaning, fishing, open defecation and leachates from solid wastes like the paper, polythene bags, plastic cups, sachets, straws, cloths and leaves in addition to municipal sewage, which are nonpoint sources of pollution in the study area.

Sediment Samples

During summer, the pH of the sediment value ranged from 8.50 to 9.62 and had a mean value of 9.09, minimum value was observed in sample site 3 (S₃), maximum value was recorded in sampling site 7 (S₇). In rainy season, it ranged from 8.30 to 9.37 had a mean value of 8.89, minimum value was observed in sampling site 3 (S₃), maximum value was recorded in sampling site 5 (S₅).

Arivoli et al.**Electrical Conductivity**

Electrical Conductivity during summer sediment value ranged from 10.2 to 990.0 mS/cm and had a mean value of 552.96 mS/cm, minimum value was recorded in sampling site S10, maximum value was observed in sample site 7 (S7). In rainy season, EC sediment value ranged from 6.20 to 733 mS/cm and had a mean 277.2 mS/cm, minimum value was observed in sampling site 4 (S4), maximum value was observed in sampling site 2 (S2).

Oxidation Reduction Potential

Oxidation Reduction Potential is the activity or strength of oxidizers and reducers in relation to their concentration. ORP of the sediment samples ranged -108 to 136.00 mV and had a mean value of 29.63 mV, minimum value was recorded in sampling site 7 (S7), maximum value was recorded in sampling site 8 (S8). In rainy season, ORP value ranged from -112 to 112 mV and had a mean value of -3.25 mV, minimum value was observed in sampling site 7 (S7), maximum value was recorded in sampling site 11(S11).

Total Organic Carbon (TOC)

During summer, Total Organic Carbon (TOC) value ranged from 16.00 to 18.90 % and had a mean value of 17.17 %, minimum value was recorded in sampling site 1 (S1), maximum value was observed in sampling site 11 (S11). In rainy season TOC value ranged from 3.28 to 8.08% and had a mean value of 6.41%, minimum value was observed in sampling site 9 (S9), maximum value was recorded in sampling site 11 (S11). TOC can have its origin either from organic matter from natural sources such as plant minerals deposited on sediments or anthropogenic inputs to aquatic systems [24].

Available phosphorus

Available phosphorus during summer sediment samples ranged from 10.4 to 25.2 gm/kg and had a mean value of 18.64 gm/kg, minimum value was recorded in sampling site 2 (S2), maximum value was observed in sampling site 11 (S11). In rainy season TOC value ranged from 6.0 to 20.00 gm/kg, minimum value 6.00 gm/kg was observed in sampling site 2 (S2), maximum value was recorded in sampling site 6 (S6).

Sodium

During summer, sodium value ranged from 254.6 to 290.70 gm/kg and had a mean value of 275.33 gm/kg, minimum value was recorded in sampling site 7 (S7), maximum value was observed in sampling site 11 (S11). In rainy season, available phosphorus value ranged from 220.50 to 247.50 and had a mean value of 231.75 gm/kg, minimum value was observed in sampling site 12 (S12), maximum value was recorded in sampling site 10 (S10).

Potassium

In summer, potassium sediments value ranged from 447.20 to 496.7 gm/kg and had a mean value of 472.83 gm/kg, minimum value was recorded in sampling site 1 (S1), maximum value was observed in sampling site 12 (S12). In rainy season, potassium value ranged from 425.50 to 484.00 gm/kg and had a mean value of 449.5gm/kg, minimum the value was observed in sampling site 2 (S2), maximum value was recorded in sampling site 12 (S12).

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Calcium

During summer, calcium sediment value ranged from 520.00 to 1120 gm/kg and had a mean value of 834.16 gm/kg, minimum value was recorded in sampling site 5 (S5), maximum value was recorded in sampling site 6 (S6). In rainy, season calcium value ranged from 340.00 to 1080 gm/kg and had a mean value of 758.33 gm/kg, minimum value was observed in sampling 5 (S5), maximum value was observed in sampling site 6 (S6).

Magnesium

Magnesium during summer sediment value ranged from 370.00 to 950.00 gm/kg and had a mean value of 610.83 gm/kg, minimum the value was observed in sampling site 5 (S5), maximum value was recorded in sampling site 1 (S1). In rainy season, magnesium value ranged from 160 to 800.00 gm/kg and had a mean vale of 443.30 gm/kg, minimum value was recorded in sampling site 5 (S5) the maximum value was recorded at in sampling site 1 (S1).

Sodium Adsorption Ratio (SAR)

During the summer Sodium Adsorption Ratio (SAR) sediment value ranged from 1.47 to 2.21 (meq/l)^{1/2} and had mean value 1.77 (meq/l)^{1/2}, minimum value was recorded in sampling site 1 (S1), maximum value was recorded in sampling site 5 (S5). In rainy season SAR value ranged from 1.42 to 2.64 (meq/l)^{1/2} and had a mean vale of 1.78 (meq/l)^{1/2}, minimum value was recorded in sampling site 1 (S1) the maximum value was recorded in sampling site 6 (S6). It is a measure of the suitability of water for use in agricultural irrigation, as determined by the concentrations of solids dissolved in the water. It is also a measure of the sodicity of soil, as determined from analysis of water extracted from the soil.

When compared the summer and rainy seasonal, except TDS, Dissolved Oxygen and phosphate all other parameters are found to higher in summer season. TDS, DO, DO saturation Index and phosphate of water sample and pH, EC, ORP, TOC, Available phosphorus, potassium, calcium, magnesium and sodium of sediment sample were recorded to be higher in rainy season.

CONCLUSION

The seasonal analysis showed that Gundur Lake was polluted in both the season. But maximum level of pollution load was observed during summer. The high level of pollution may be due to domestic sewage discharge, washing, bathing and microbial decomposition of organic matter which these lakes due to anthropogenic activities were highly polluted.

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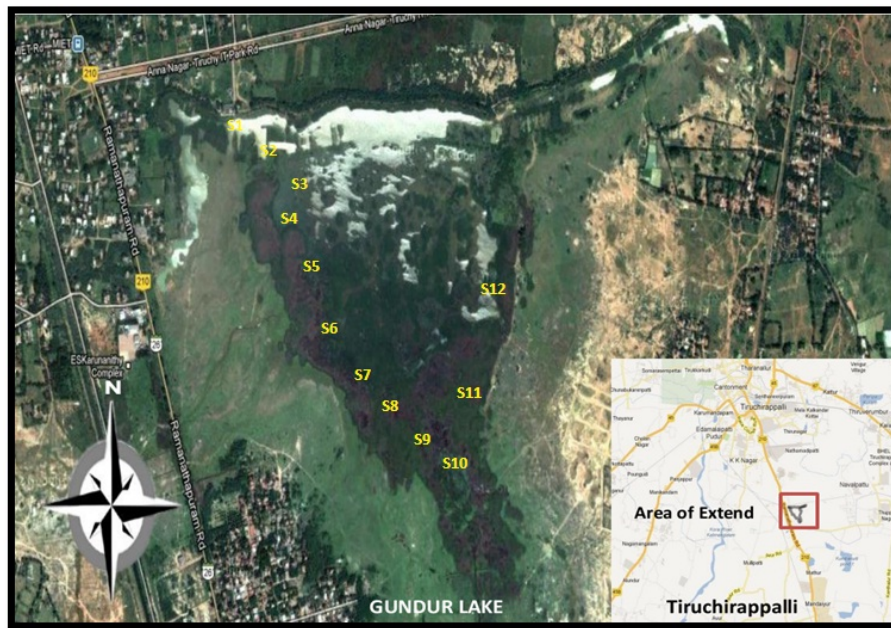


Fig. 1: Gundur Lake,India

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Table. 1 Summary statistics for the Physico chemical characteristics of lake water and sediment sample (summer and rainy season)

Parameters	Summer season				Rainy season			
	Min	Max	Mean	Stand. dev	Min	Max	Mean	Stand. dev
Water samples								
Temperature	29.00	30.00	29.67	0.66	28.00	30.00	28.75	0.62
pH	8.22	9.84	9.09	0.45	7.96	8.84	8.30	0.25
E.C. (mS/cm)	1.15	2.34	1.55	0.33	0.90	2.22	1.22	0.38
TDS(mg/l)	320.00	840.00	502.75	141.94	467.00	1170	618.25	204.83
Salinity(mg/l)	580.00	1520	797.50	272.6	560.00	1390	740.83	242.8
Chloride (mg/l)	120.53	292.33	183.30	42.58	92.17	276.51	158.90	47.66
Hardness (mg/l)	180.00	490.00	252.50	82.7	130.00	440.00	180.00	83.23
Total Alkalinity(mg/l)	160.00	250.00	189.17	23.14	112.00	210.00	168.5	26.06
D.O(mg/l)	4.18	5.90	5.27	0.44	4.400	6.40	5.63	0.60
DO Saturation	60.00	80.00	68.75	5.69	60.00	80.00	71.67	6.69
BOD ₅ (mg/l)	56.40	102.50	81.24	23.33	31.25	125.00	61.99	32.23
COD(mg/l)	155.6	420.00	192.88	72.75	132.00	375.00	169.31	66.47
PO ₄ (mg/l)	5.00	10.50	7.54	1.66	10.00	38.00	23.23	8.05
NO ₃ (mg/l)	8.83	46.51	28.63	9.82	4.00	21.00	12.83	4.41
SO ₄ (mg/l)	7.50	20.50	10.21	3.52	5.00	18.50	7.32	3.58
Na(mg/l)	125.80	180.40	145	18.6	105.3	160.90	124.55	18.98
K(mg/l)	90.50	230.40	128.59	46.1	85.3	216.20	113.98	45.47
Sediment samples								
pH	8.50	9.62	9.10	0.42	8.30	9.37	8.89	0.38
EC(mS/m)	10.2	990.00	552.96	414.10	6.20	733.00	277.20	276.21
ORP(mV)	-108.00	136.00	-25.83	89.77	-123.00	112.00	-3.25	102.67
TOC (%)	16.00	18.90	17.18	0.81	3.28	8.08	6.41	1.49
Avil.PO ₄ (gm/Kg)	10.40	25.20	18.64	4.09	6.00	20.00	14.42	4.11
Na(gm/Kg)	254.60	290.70	275.33	13.48	220.50	247.50	231.75	10.07
K(gm/Kg)	447.20	496.70	472.83	17.29	425.50	484.00	449.50	19.50
Ca(gm/Kg)	520.00	1120.00	834.17	210.69	340.00	1080.00	758.33	227.63
Mg(gm/Kg)	370.00	950.00	610.83	164.84	160.00	800.00	443.33	170.74
SAR	1.47	2.21	1.79	0.21	1.42	2.64	1.78	0.38

ORP= Oxidative Reduction Potential, TOC= Total Organic Carbon, SAR= Sodium Adsorption Rat

Analysis of Current Environmental Status of Sasthamkotta Lake, Kerala.

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ABSTRACT

Sasthamkotta Lake and its surrounding areas fall mostly within the Tertiary Province of South Kerala. Fringed to the south-east by garnet biotite gneiss/garnet sillimanite-graphite gneiss exposures. It spreads to an area of about 4.64 km². Except on the southern side, on the other and is a low lying land of steeply sloping hillocks. The southern side, on the other hand is a low lying land of alluvial sediments which is now used for paddy cultivation. The paddy fields by an artificial barrier. The Lake, which is the main source of drinking water for Kollam Municipality and suburbs, is under serious threat due to sedimentation, siltation and pollution affecting the whole aquatic environment and consequently the unique biodiversity, land and people. Immediate corrective measures are needed to ensure ecological sustainability by way of integrated management, development and conservation of this important wetland ecosystem.

Key words: Siltation, Biodiversity, Conservation, Aquatic environment, Wetland ecosystem.

INTRODUCTION

The word "Lake" is used loosely to describe many types of water bodies – natural, manmade and ephemeral including wetlands. Many of them are euphemistically called Lakes more by convention and a desire to be grandiose rather than by application of an accepted definition. Vice versa, many lakes are categorized as wetlands while reporting under Ramsar Convention. Sasthamkotta lake is the largest freshwater lake in Kerala, located in the Kollam district and it serves as the source of drinking water. (Fig:4) A number of investigations were carried out in this lake to study the biological aspects, ecology, water quality assessment and conservation plans.

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Location of the lake	:	Kollam, Kerala
Total catchment Area	:	9.04 Km ²
Total area of the lake	:	4.64 Km ²
Capacity of the lake	:	22.39 Mm ³
Total drainage area	:	4.04 Km ²

Water availability in the Lake

The quantity of water available in the Lake has been mostly a subject of speculation. Accounts of depth varied from 10 to 30 m [6]. Measurements on 30th April 1989 using weight and line and disc tied to a string indicated a maximum depth of 13.9m with a calculated average of 6.8m [6]. It was also noticed that water column went up by 1.5 m during rainy season. Detailed bathymetric survey using Honey Well ELAC 4100 Shallow Water Echosounder indicated a maximum depth of 13.3 m [1]. Discrepancy in the reported depths may be either due to the accuracy levels involved in measurements using different techniques or may be attributed to the water level differences in the years in the absence of 0 level marking or as a result from siltation of the Lake.

Water level

Water level in the Lake recorded during April-May period is lowest and the level starts increasing with the on set of monsoon and by the end of south-west and North-East monsoons, the level comes to a peak in October-November. This increase in level is around 1.5m depending on the amount of rainfall. Later it keeps on declining, indicating thereby that monsoon rain is the major source of water in the lake. Water loss takes place through evaporation and daily pumping out of water for drinking purpose. Water is mostly calm, occasional wind action produces waves on the water surface and occasionally froth at the border.

Depth of Sasthamkotta lake and quantity of water available in the lake have been a subject of speculation. Accounts of depth varied from 30m to 10m [6]. Borewell data from west Kallada, in the south-western fringe of the lake on the right bank of the Kallada river shows presence of sand bed of different grain size upto 9.14m to 40.2 m sands, occasionally clayey upto 61.58m and clays further below upto 64 m where the well was bottomed [7].

Water quality of the Lake

Water quality problems associated with Sasthamkotta Lake includes severe dissolved oxygen depletion, moderate water clarity and high level of algae growth, and dense beds of aquatic microphyte. There is therefore a need to properly manage wastes in the surrounded bund width and control as well as monitor human activities in order to ensure that such activities have minimal negative effects on lakes.

Fish abundance

Earlier, Thomas *et al.*, (1980) [9] reported 23 species of fish belonging to 17 genera in Sasthamkotta Lake. Fresh water prawns recorded from the Lake are Macrobrachium and Caridina. The Lake is famous for pearl spot. *Etroplus suratensis* (Karimeen). Fishes are caught during day and night using traditional methods. The fish species recorded during the study period are given the following table.1.

Sedimentation

Sediments in lake vary according to the origin of lakes. Glacial lakes receive different materials from rivers, streams and shorelines which range from large boulders, rocks, pebbles and coarse sands to fine sands, silts and clay. (fig:1) In addition, organic debris resulting from eutrophic processes in lake settles to the bottom and mingles with

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inorganic sediments. As lake becomes more eutrophic and organic deposition increase, the organic content of sediments increases which promotes increased vegetation growth intern adding more organic material to the sediments and hastening the death of the lake. Oxygen demand also increases with increased organic sedimentation [2].

Natural vegetation

The natural vegetation in the catchment area is fastly on the decline due to indiscriminate felling, uncontrolled grazing and poor management. There is no extensive natural area available in the catchment and natural vegetation and flora are composed of only those indigenous species naturally growing in the homesteads, patches of wastelands, along the Kallada canal sides and much disturbed sacred groves, etc., Species identified from Sasthamkotta Lake are presented in the table.2.

Avian Fauna

Wetlands are important bird habitats and they used for their livelihoods. Wetlands have been drained, modified, or created to produce or enhance agricultural crops and also treated as waste disposal areas around the world. This degradation has an incalculable effect on wildlife numbers, water quality, hydrological cycles and other wetland functions and values. Wetlands are the important bird habitats and they use them for feeding, roosting and breeding. [8,10]. As a wetland ecosystem this area is important for the breeding and roosting birds and several other taxa of flora and fauna. This region is the biggest and the primary roosting and nesting grounds for many wetland wading birds. Indian darters or the snake birds (*Anhinga melanogaster*) were found abundantly in Sasthamkotta Lake. List of birds observed from the lake are given in the table.3.

Pollution caused by Urban and Agricultural

The domestic waste from the thickly populated belt around the Lake and the fertilizers from surrounding farmlands in the catchment area polluted the Lake. The excessive pressure of population together with dearth of minimum sanitation and drainage facilities has caused serious pollution problems to the Lake.

Fertilizers and Chemicals

The use of fertilizers and chemicals causes agricultural surface pollution and water deterioration in the Lake region where 75% of the population is rural. The main agricultural goods are tapioca, cashew, rubber, mango, jack, paddy, etc., farmers continually use chemicals and intensive agricultural methods in order to improve yields. More than 60% of the cultivated land in the catchment area of Sasthamkotta Lake is under homestead cultivation. Where marginal and small farmers have coconut as the main crop, inter-cropped with a variety of perennials and/or seasonal [4].

Soil erosion in the Lake region has been an important factor with a negative impact on this region's ecological environment. The situation of erosion in different areas is not the same More than 50% of Lake's bund suffers from soil erosion. During recent decades, the situation of soil erosion is getting worse due to the low forest coverage and fast population growth. Added to this, the upper catchment of the wetland has very steep slopes and poor management. Along with deforestation, changes in land use also have taken place. Many settlements have come, especially, since the average density of population in this area is 1000/km², the highest density of population being in the lower reaches of the wetland. Indiscriminate felling of trees, uncontrolled grazing, unscientific agricultural and allied practices, construction activities and urbanization in the watershed have accelerated soil erosion causing very high sedimentation.

Rajesh et al.**Population**

The increasing population in Sasthamkotta Lake region (estimated at 20 to 40%), particularly the fast growing, urbanization and industrialization. These are major factors that cause total imbalance of this region's ecological system [3]. In comparison with other regions, the population density in this Lake region is very high. This population requires and consumes constantly increasing amounts of resources, including water and energy. It also generates waste that goes back into the ecosystem.

Residential Activities

The large population in the Lake region produces a huge amount of everyday life wastes and puts a lot of pressure on the regional environment.(Fig:2 , 3)) The number of inhabitants on the banks of the Lake has been on the increase recently. Many families do not have proper sanitary facilities. They defecate on the banks and use the Lake water for bathing and washing clothes. Thus pollution from faecal matters, domestic waste, agricultural run-off, soaps and detergents, etc., pose major threat to the quality of Lake water.

Lake conservation

Soil and moisture conservation: Trees, shrubs and grasses can be planted on degraded slopes, either alone or in combination. A dense network of roots in the soil and a canopy overhead helps to protect the slope from erosion [5].

Biodiversity conservation

The area in general supports a wealth of flora and fauna. Though the natural vegetation in the area as a whole is fast on the decline due to various indiscriminate activities, a few sacred groves still exist in the catchment as relics of the once luxuriant vegetation. They serve as refugia of many endemic and threatened species of plants and animals and also serve as a source of ethnomedicinal plants. They represent the living testimony of the conservation ethos upheld by the local residents. The freshwater lake, a unique ecosystem harbours a diverse flora and fauna comprising of phytoplanktons, zooplanktons, fishes, amphibians, etc., the wetland as a whole attracts a vivid avian fauna which includes large numbers of seasonal migrating members. Infiltration pits serve the purpose of enhancing the flow of water into the soil and are designed to improve ground water regimes. Diversion ditches of the size 5 m are designed to prevent waste water from entering the Lake directly. Nearly 25 ditches taking into consideration of nature terrain and bathing points.

CONCLUSION

The Sasthamkotta Lake basin faces the problems of increasing pressure on its ecosystem due to the large and growing regional population and environmental deterioration caused by continuing industrialization, urbanization, pilgrim activities and land degradation. The ecological burden from the growing population is going to further create more difficulties in dealing with the water related issues. Solving Lake basin's problems of water deterioration will add more pressure on the region's economy. In order to understand the real reasons of the ecological problems in the Lake basin and solve them in an effective way, it is essential to provide sustainable water resources for the residents in the region, the local governments, community and NGOs need to collaborate to make strategic policies and promote environmental education as well as improve the legal systems and regulations to monitor and manage Sasthamkotta Lake's regional water resources.

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**Fig: 1. Sedimentation found at Lake****Fig: 2. Population activities****Fig: 3. Anthropogenic activity****Fig: 4 .View of Sasthamkotta lake**

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Table: 1 Fishes recorded from Sasthamkotta Lake

S.No.	Species
1	<i>Megalpos cyprinoides</i>
2	<i>Glossogobius giuris giuris</i>
3	<i>Mystus gulio</i>
4	<i>Etroplus suratensis</i>
5	<i>Etroplus maculatus</i>
6	<i>Puntius filamentosus</i>
7	<i>Puntius ticto</i>
8	<i>Puntius sarana subnasutus</i>
9	<i>Heteropneustes fossilis</i>
10	<i>Macrognathus guentheri</i>

Table: 2 Vegetation recorded from the lake

Trees	Shrubs	Herbs	Sacred groves
<i>Artocarpus hirsute</i>	<i>Clerodendron infortunatum</i>	<i>Ananas comosus</i>	<i>Adenthera pavonina</i>
<i>Bambusa bamboos</i>	<i>Kirganelia reticulata</i>	<i>Vanda tessellate</i>	<i>Alstonia scholaris</i>
<i>Cinnamomum sulphuratum</i>	<i>Osbeckia aspera</i>	<i>Abutilon indicum</i>	<i>Cinnamomium verum</i>
<i>Dendrocalamus strictus</i>	<i>Eupatorium adenophorum</i>	<i>Mimosa pudica</i>	<i>Cleistanthus collinus</i>
<i>Mallottus stenanthus</i>	<i>Lantana camara</i>		<i>Diospyros paniculata</i>
<i>Olea dioica</i>	<i>Grewia sp.</i>		<i>Ficus religiosa</i>
<i>Bombax ceiba</i>	<i>Pavetta indica</i>		<i>Holarrhena pubescens</i>
<i>Tamarindus indica</i>			<i>Olea dioica</i>
<i>Macaranga peltata</i>			<i>Lannea coromandelica</i>
<i>Samanea saman</i>			<i>Morinda pubescens</i>

Table. 3 Birds recored from the lake

Common name	Scientific Name
Little Grebe	<i>Tachybaptus Ruficollis</i>
Little Heron	<i>Butorides striatus</i>
Great Cormorant	<i>Phalacrocorax carbo sinensis</i>
Indian Cormorant	<i>Phalacrocorax fuscicollis</i>
Little Cormorant	<i>Phalacrocorax niger</i>
Darter	<i>Anhinga rufa melanogaster</i>
Grey Heron	<i>Ardea cinerea rectirostris</i>
Purple Heron	<i>Ardea purpurea manilensis</i>
Great Egret	<i>Casmerodius albs</i>
Little Heron	<i>Butorides striatus</i>
Indian Pond Heron	<i>Ardeola grayii grayii</i>

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Cattle Egret	<i>Bubulcus ibis coromandus</i>
Intermediate Egret	<i>Mesophoyx intermedia</i>
Little Egret	<i>Egretta garzetta garzetta</i>
Marsh Sandpiper	<i>Tringa stagnatilis</i>
Nordmann's Greenshank	<i>Tringa nebularia</i>
Wood Sandpiper	<i>Tringa glareola</i>
Common Sandpiper	<i>Actitis hypoleucos hypoleucos</i>
Whiskered Tern	<i>Chlidonias hybridus indica</i>
Gull-Billed Tern	<i>Gelochelidon nilotica</i>
Rock Pigeon	<i>Columba livia intermedia</i>
Spotted Dove	<i>Streptopelia chinensis suratensis</i>
Rose-Ringed Parakeet	<i>Psittacula krameri manillensis</i>
Plum-Headed Parakeet	<i>Psittacula cyanocephala</i>
Common Hawk-Cuckoo	<i>Hierococcyx varius</i>
Banded Bay Cuckoo	<i>Cacomantis sonneratii</i>
Asian Koel	<i>Eudynamys scolopacea</i>
Jungle Owlet	<i>Glaucidium radiatum malabaricum</i>
Spotted Owlet	<i>Athene brama</i>
Asian Palm Swift	<i>Cypsiurus balasiensis</i>
Pied Kingfisher	<i>Ceryle rudis travancoreensis</i>
Common Myna	<i>Acridotheres tristis</i>
Southern Jungle Myna	<i>Acridotheres fuscus mahrattensis</i>
Rufous Tree Pie	<i>Dendrocitta vagabunda parvula</i>
House Crow	<i>Corvus splendens protegatus</i>
Large-Billed Crow	<i>Corvus macrorhynchos culminatus</i>
Common Iora	<i>Aegithina tiphia multicolor</i>
Red-Whiskered Bulbul	<i>Pycnonotus jocosus fuscicaudatus</i>
Yellow-Billed Babbler	<i>Turdoides affinis affinis</i>
Paradise Flycatcher	<i>Terpsiphone paradisi paradisi</i>
Zitting Cisticola	<i>Cisticola juncidis salimalii</i>
Common Tailor Bird	<i>Orthotomus sutorius guzuratus</i>
Blyth's Reed Warbler	<i>Acrocephalus dumetorum</i>
Greenish Leaf Warbler	<i>Phylloscopus trochiloides nitidus</i>
Oriental Magpie-Robin	<i>Copsychus saularis ceylonensis</i>
Paddyfield Pipit	<i>Anthus rufulus</i>

Flavonoid Glycosides as Ligands for Cancer Target using Computational Analysis.

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ABSTRACT

Phytochemicals are naturally occurring biologically active chemical compounds in plants which have a natural defence system for host plants and provide colour, aroma and flavour. These are also protective and disease-preventing particularly in some forms of cancer and heart diseases. Among the thousands of phytochemicals, flavonoids constitute a large group which grows extremely quick and exists in glycosylated form they enhance the effects of vitamin C and function as antioxidants and are also known to be biologically active against liver toxins, tumours, viruses and other microbes, allergies and inflammation. Our study focused on the computational analysis of flavonoid glycosides with cancer target. Flavonoid glycosides from various plant sources were collected. Its chemical structure were modelled in Chems sketch and converted into mol format. 3UBD is ribosomal S6 kinase is the main protein which promotes human HNSCC cell invasion and metastasis and was identified as disease target. The phytocompounds were used as ligands and docked against the disease target using Schrodinger Glide. This analysis concludes that phytocompounds serve as important components of traditional medicines, due to its structure-effect correlations that is positional changes of OH groups bring about dramatic changes in their biological effects.

Keywords: Phytochemicals, Flavonoid glycosides, Cancer, Ribosomal S6 kinase, Glide docking.

INTRODUCTION

Phytochemicals are naturally occurring biologically active chemical compounds in plants that has a natural defence system for host plants and provide colour, aroma and flavour. Any one serving of vegetables could provide as many as 100 different phytochemicals. The most important action of these chemicals with respect to human beings is that

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they function as antioxidants that react with the free oxygen molecules or free radicals in our bodies. These are also protective and disease-preventing particularly for some forms of cancer and heart diseases. The large group of phytochemicals, Flavanoids are found in almost all plant based food and beverages. Flavanoids enhance the effects of vitamin C and function as antioxidants. They are also known to be biologically active against liver toxins, tumours, viruses and other microbes, allergies and inflammation [5]. Most compounds produced by plants are polyphenols occur in their glycosylated forms. Phenolic OH groups are good targets for biological glycosylations. Among the glycosides of polyphenolic compounds, flavonoids constitute a large group which grows extremely quick [2].

The glycosidic residues are crucial for their activity & improve pharmacokinetic parameters. Hence results in the development of new, more active or more effective glycodrugs [2]. Glycosides are highly watersoluble. Attaching of the glycosidic moiety into the molecule increases its hydrophilicity in turn influences pharmacokinetic properties of the compounds, e.g., circulation, elimination and the concentrations in the body fluids. Glycosylation can strongly influence transport through some important barriers as the haemato-encephalitic barrier and block the entrance of many compounds into the brain tissue. Some glucosides can be transported actively into the brain tissue using the glucose-transport system. These serve as important components of traditional medicines, due to its structure-effect correlations ie., positional changes of OH groups bring about dramatic changes in their biological effects[9].

MATERIALS AND METHODS

PDB (Protein Data Bank)

The Protein Data Bank (PDB) is a repository for the 3-D structural data of large biological molecules, such as proteins and nucleic acids. The data obtained by X-ray crystallography or NMR spectroscopy are submitted by biologists and biochemists from around the world, which are freely accessible on the Internet via the websites of its member organizations.

CHEMSKETCH

ACD/ChemSketch is a chemical drawing software package from Advanced Chemistry Development, Inc. designed to be used alone or integrated with other applications. ChemSketch is used to draw chemical structures, reactions and schematic diagrams.

SCHRODINGER GLIDE

Schrodinger Software is a suite of computational tools to solve real-world problems in life science and molecular chemistry research. Maestro is the unified interface for all Schrödinger software. Impressive rendering capabilities, a powerful selection of analysis tools, and an easy-to-use design combine to make Maestro a versatile modeling environment for all researchers. It can be used to build, edit, run and analyse molecules. Glide is a well-known ligand docking program developed by SCHRODINGER. Glide offers the full spectrum of speed and accuracy from high-throughput virtual screening of millions of compounds to extremely accurate binding mode predictions, providing consistently high enrichment at every level.

Methodology

The chemical structures of flavonoid glycosides isolated from various plants reported in literature were collected. These chemical structures were drawn using ChemsKetch. Disease target protein 3D structure was downloaded from Protein DataBank in PDB format. The chemical structures (flavonoid glycosides) were used as ligands and docked against the target protein. The docking procedure in Schrodinger Glide involves the following steps: Ligand minimization & preparation; Protein (receptor) preparation; Grid Generation; Docking and Analysis.

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RESULTS AND DISCUSSION

Table 1: 12 Flavonoid Glycosides were reported from 5 different plants.

Plant name	Flavonoid Glycoside [FG](reported in literature) with ID	References
<i>Bassia muricata</i>	quercetin-3-O-(600-caffeoyl)-sophoroside (C1)& quercetin-3-O-(600-feruloyl)-sophoroside (C2)	Mohamed et al., 2001, [4].
<i>Morinda citrifolia</i>	quercetin-3-O-"-L-rhamnopyranosyl-(1->6)-β-D-glucopyranoside (D1)& kaempferol-3-O-"-L-rhamnopyranosyl-(1->6)-β-D-glucopyranoside (D2)	Shixin et al., 2011,[6].
<i>Chrysanthemum morifolium</i>	luteolin 4'-methoxy-7-O-(6"-O-acetyl)-β-D-glucopyranoside (L1)& acacetin 7-O-(3"-O-acetyl)-β-D-glucopyranoside (L2)	Jian et al., 2006,[3].
<i>Neolitsea sericea</i>	(2S,3S)-Dihydroquercetin 3-O-_-L-rhamnoside (G1), (2R,3R)-Dihydroquercetin 3-O-_-L-rhamnoside (G2) & (2S,3R)-Dihydroquercetin 3-O-_-L-rhamnoside (G3)	Sio-Hong et al., 2008,[7].
<i>Cadapa glandulosa</i>	rhamnocitrin-3-O-neohesperoside-4_-O-glucoside (F1), rhamnocitrin-3-O-neohesperoside (F2)& rhamnetin-3-neohesperoside (F3)	Ahmed , 2002,[1].

Table 2: Docking scores of target protein with Flavonoid Glycoside ligands.

Plant Name	Phytoconstituents ID	Glide Docking Score
<i>Bassia muricata</i>	C2	-5.91
<i>Morinda citrifolia</i>	D2	-5.03
<i>Cadapa glandulosa</i>	F3	-4.88
	F2	-3.90
	F1	-3.66
<i>Chrysanthemum morifolium</i>	L1	-2.58
<i>Neolitsea sericea</i>	G2	-2.20

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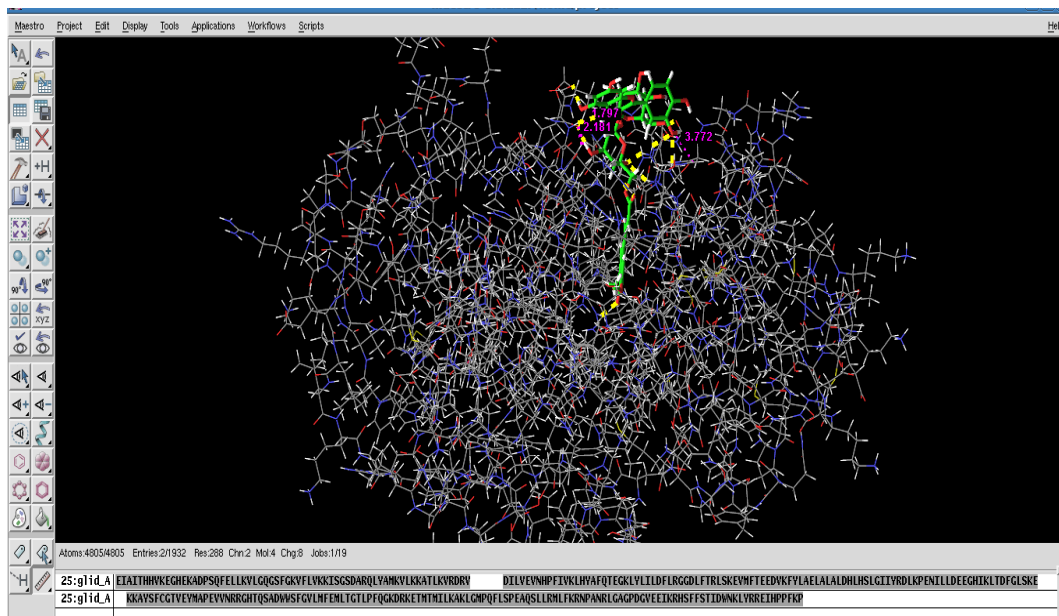


Fig.1: Docking of FG(C2) with cancer protein showing Hydrogen Bond interactions (Yellow dotted lines)

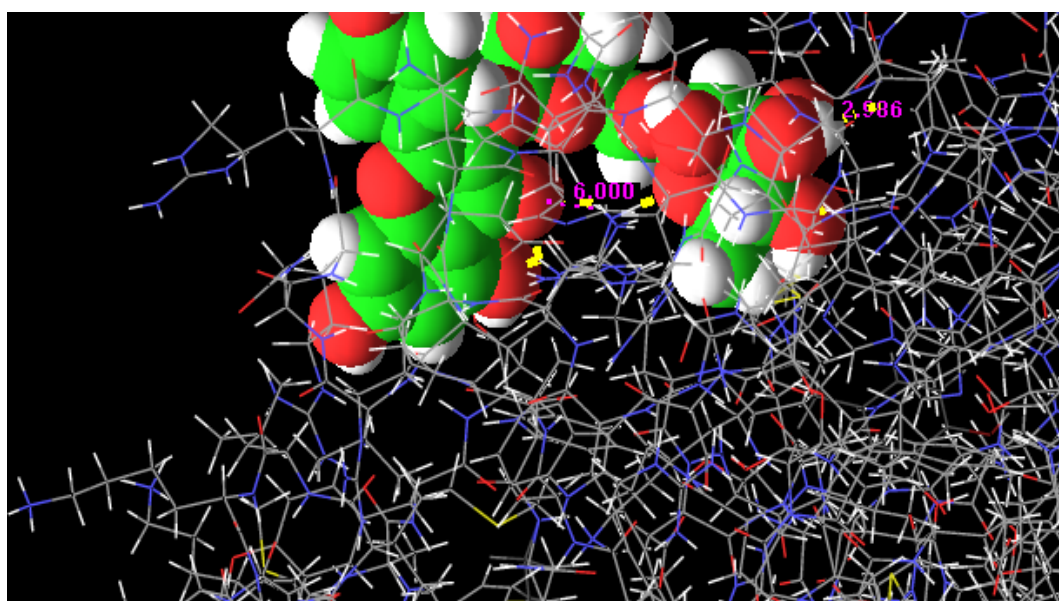


Fig.2: Docking of FG (D2) with cancer protein showing Hydrogen Bond interactions (Yellow dotted lines)

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CONCLUSION

Medical research into these powerful plant extracts is uncovering a wealth of health benefits, including the reduction of the risk of cancer, arthritis, heart disease, and other conditions that rob us of quality of life which lead to premature aging and death. Recent research reported Flavonoids as promising anti-cancer agents, and glycosides (sugar moiety) when combines with these flavonoids enhances the Drug ADMET efficacy. Hence from our research findings we can say that these phytochemicals [FG] could be a future drug candidate in the field of cancer research.

ACKNOWLEDGEMENTS

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