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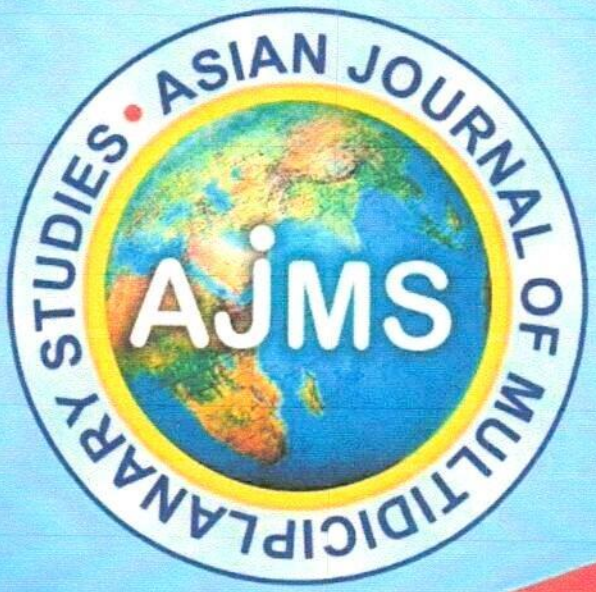

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Physico-chemical investigation of public water supply schemes from Krishna River in Palus Tahasil of Sangli District, M. S., India

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Abstracts: Physicochemical investigation of water from public water supply schemes was carried out with the objective of assessing its potabiliy for drinking purpose. It was observed that, lowest BOD value of 5.3 mg/L and highest BOD value of 8.1 mg/L where as the lowest COD of 75.3 mg/L and highest COD of 112.30mg/L.. DO ranged from 3.4 to 6.3 mg/L. Electrical Conductivity was from 578 to 710 umho/cms which is below the permissible limit. The total hardness was from 33.89 to 20.99 mg/l, pH was acidic to mild alkaline. The Suspended solids and total dissolved solids were within permissible limit. The total dissolved solids were within the ranges of 504.3 mg/L to 609.2 mg/L. All the samples were found to be suitable for drinking purpose.

Key Words: physico- chemical investigation, public water, BOD, u to beCOD, DO, Electrical Conductivity, hardness, suspended solids, dissolved solids, Total solids.

Introduction:

Clean water is one of the nature's greatest gift to mankind. Unfortunately, the clean water resources are not only shrinking in size but are also getting more polluted thus, becoming less suitable for various purposes.[7] Water is mainly important for domestic purpose. It is generally supplied by Municipal, Gram Panchayat Schemes or by a public supply system[8] in urban and rural population areas respectively. Lack of safe drinking water and adequate sanitation measures lead to a number of diseases such as cholera, dysentery, salmonellosis and typhoid and every year thousands of lives are claimed in and around Sangli district. Diarrhea is the major cause for the death of more than two million people per year worldwide, mostly children under the age of five. It is a symptom of infections or the result of combination of a variety of enteric pathogens[1].Majority of the populations are heavily dependent on and are concerned about the quality for direct consumption and the other uses.

Water borne pathogens infect around 250 million people every year resulting in 10 to 20 million deaths worldwide2. In Sangli district 34% of the population from rural area does not have access to potable water supply and nearly 32% of the population from rural area lack basic sanitation. This highlights the potential of infections due to water borne pathogens.

The evaluation of potable water supplies for coliform bacteria is important in assessing the quality of drinking water. High level of coliform counts indicates a contaminated source, inadequate treatment or post- treatment deficiences[5]. Many developing regions suffers from either chronic shortage of fresh water or the readily accessible water resources are heavily polluted.[13] Microbiological health risks remain associated with many aspects of water use, including drinking water in developing countries[17], irrigation reuse of treated waste water and recreational water contact[9]. It has been reported that drinking water supplies have a long history of association with wide spectrum of microbial infections[19].

Material and Method:

The Krishna is one of the three largest sacred rivers of southern India. It originates from Mahabaleswar in Maharashtra (located in the west of India) and goes into the mouth of Bay of Bengal (On east cost of India). Approximately 105 kms of the river course falls inside the Sangli district.

Sangli is one of the southern district of Maharashtra lying between 16° 43' to 17° 38' north latitudes and 73°41' and 75° 41' east longitudes and has area of 8591.3 sq. km. It is lying mainly in the basin of river Krishna, tributaries of Warana, Yerala, Agrni, Man, Nandani. It has ten tahsil of which Palus tahsil lying between 17°02' north latitudes and 74°22' east longitudes and has area of 8591.3 sq. km. receives Drainage discharge from twelve villages at the bank of Krishna river.

The water from Krishna river is used for domestic, industrial and irrigation purpose all over the Sangli district. In the last few decades, there has been a tremendous increase in the demand for fresh water due to rapid growth of population and the accelerated pace of industrialization. Human health is threatened by most of the agricultural development activities particularly in relation to excessive application of fertilizers and unsanitary conditions that is unscientific waste disposal and carelessness towards the environment and causing

environmental degradation[6]. The pollution in River Krishna is increasing and it is dying at an increasing rate. The river receives the waste drainages and sewages from the large number of villages from Palus tahasil including Tupari, Dudhondi, Punadi, Nagrale, Burli, Amanapur, Tavadervadi, Audumber, Bhilawadi, Ankalkhop, Brahmnaal, and Nagthane etc.

Sampling:

Water samples used for drinking purpose were collected from twelve villages from public supply system of Krishna river basin in Palus tahasil of Sangli district in November 2013 . Polythine containers of two liter capacity, which were pre-treated with dilute nitric acid, dried and rinsed three times with the sample water which was used for collecting water samples. Water temperature was recorded on the spot using $1/10^{th}$ Mercury Thermometer. The samples were taken to the laboratory and preserved in the Refrigerator. To identify and locate the samples easily, all samples carried self-adhesive labels. These were affixed on the sample bottles instead of the cover to prevent loss or misplacing causing sample mix-up. The information on the sample label includes location, date, time and temperature. The physico-chemical analysis was done as per the standard methods[4, 25].

Result and Discussion:

The sample coding for each Village in palus tahasil of Sangli District is given in Table.1

Data on physico-chemical characteristics of the Water samples collected from twelve villages from public supply system of Krishna river basin in Sangli district are as shown in Table. 2

Direct consumption of untreated water is potentially hazardous, and risk increases as drainage discharge increases which also causes changes in the physiological and structural aspects of the inhabitant organism, particularly the fishes[3]

Physical Properties:

Researchers over the years have shown that physical parameters such as pH, Temperature and Turbidity have a major influence on bacterial population growth[5, 9].

1. BOD: Biological oxygen demand is an important parameter to assess the pollution of waters, where the contamination occurs due to disposal of domestic and industrial effluents. The low and high values for BOD were 5.3 mg/L and 8.1 mg/L in Samples A and H respectively.

2. COD: Chemical oxygen demand estimates the carbonaceous fraction of organic matter. Values for COD were 75.3 mg/L and 112.30mg/L respectively for the sample E and I.

3. Color: When pollutants like sewage, drainage, industrial waste mixed with the water, the water reveals the color of pollutants. Color of the water is indicative of the degree of the pollution caused by human material, drainage, plant weeds, metallic substances and protozoans. The samples in the study during investigation were found predominantly colorless.

4. Dissolved Oxygen: Dissolved oxygen is needed for living organisms to maintain their biological process. In the water medium it plays a vital role for supporting aquatic life. It is susceptible to environmental changes[12]. Dissolved oxygen ranged from 3.4 mg/L for the sample A and highest 6.3 mg/L to the sample K. Higher photosynthetic action is attributed as one of the reasons for high dissolved oxygen along with low organic matter.

5. Electrical Conductivity: There are several factors that determines the degree to which water will carry an electrical current. This includes the concentration, mobility of ions, oxidation state and temperature of the water. It was observed that samples G had 578 and the samples C had 710 umho/cms which were below the permissible limit.

6. Total hardness: The presence of multivalent metal ions (calcium and magnesium) which comes from the minerals dissolved in the water is known to cause hardness in water bodies. Hardness of water is dependent upon the ability of these ions to react with soap to form a precipitate or soap scum. The reaction of iron and manganese in fresh water may contribute to the hardness of such water for domestic use. The highest total hardness for the sample D was 33.89 mg/L and the lowest for the sample G was 20.99 mg/L in the overall sampling places.

7. Odour: There was essentially no particular odour of specific nature was recorded

8. pH It indicates the acidity or alkalinity of a substance from 1.0 to 14. Acidity increases as the pH gets lower. Aquatic organism differ as the range of pH in which they live.

pH of the most of the samples was mild alkaline to a high recording of 8.3 for the sample E and lowest 7.4 for the samples H and K with corresponding high alkalinity of 167.42 and 115.43 mg/L respectively. Low pH value may be due to incoming rain water[19]. Hence, the alkaline pH of the most of the samples is explained by the fact that inadequate rain in the region, bringing in no enough water for dilution of alkaline substances resulting in keeping the pH on its higher level possible. However, in natural waters, pH usually ranges from 6.5 to 8.5 and it is bio-tolerable. The most of the samples of the study carried a pH that is conducive for the fishes living in it, Hence, the pH of the samples is within the permissible range recommended[26] by WHO (2003).

9. Suspended Solids: Suspended minerals are a measure of the amount of sediment moving along in a stream. Solids present within water bodies is highly dependent on the flow of water which

usually increases during and immediately after rain events. As the sediment settles out of the water, it gradually becomes clear, but in most cases, the aquatic habitats are often destroyed. It was observed that sample G of water are known to have this suspended solid inside them with the highest value of 98.1 mg/L while sample E having the lowest value of 94.8 mg/L. All the values were observed to be within the permissible limit.

10. Temperature: Temperature is one of the important environmental parameter in fresh water eco-system which affects the ability of water to hold oxygen, the rate of photosynthesis by aquatic plants and the metabolic rate of aquatic organisms. Cause of temperature include weather removal of shading stream, bank vegetation, impoundment, discharge of cooling water, urban storm water and ground water into to the stream.

The variation of trend in temperature noted in the present study, and it was found to be minimum for sample A (25.4°C) and maximum for sample B (27.9°C) which commensurate with the desired limit.[24]

11. Total Dissolved Solids: Total dissolved solids is an important parameter to ascertain the vulnerability of salt content in dissolved state. Total dissolved solids ranges from 410.20 to 510.93 mg/L. which shows most of the samples are within permissible limit.

12.Total Alkalinity: Alkalinity of natural water is generally due to presence of bicarbonates formed in reactions in the soil through which the water percolates and sometimes may also be due to carbonates and hydroxides. It is a measure of the capacity of the water to neutralize acids and it reflects its so- called buffer capacity.

Correspondingly, the highest alkalinity was 167.42 mg/L observed for the sample E However, the lowest alkalinity noted was 115.43 mg/L for the sample H and K.

13. Turbity: Turbidity is described as the measure of amount of particulate matter suspended in water. Water that cloudy or opaque in nature is said to be highly turbid which can cause increased water temperature because suspended particles absorb more heat and also reduce the amount of light penetrating the water.

The samples L had lowest turbidity value of 15.4 NTU and a highest of 22.3 NTU for the sample D. The values of the suspended solids ranged from 94.8 mg/L to 98.1 mg/L for the sample E and G respectively. The dissolved solids varied from 410.20 mg/L for the sample F and 510.93 mg/L for the sample K. The water found turbid or muddy in color is due to varieties of materials which are being discharged by domestic and industrial use[11] Suspended matter, in general reduces the diversity of life in aquatic systems. Total solids were recorded 609.2 mg/L as maximum in sample F and minimum 504.3 mg/L in sample F. Run off by increased inflow accounts for turbidity. Rain brings in such effects. The observations are in agreement with similar one made by Shastri[21] and Gupta[10] et.al.

14. Chemical Nutrients: Presence of nutrients and oxygen in water is essential for the sustained proliferation of organisms. However, nutrient enrichment leads to undesirable change in the structure and function of ecosystems[22]. Nutrients stimulate growth of aquatic plants which in turn decay and consume oxygen and emanate hydrogen sulphide. This accumulation exerts high biological demand on the ecosystem. In addition, with accumulation of nutrients the organic biomass increases leading to pollution[14]. The quantity of nutrients present in the water samples varies. Calcium forms the most abundant cation in freshwater. It contributes hardness to water. It has been a basic parameter for detecting pollution of water by sewage plant before development of bacteriological produces cathartic effect in human beings[23].

Calcium ranged from a low value of 18.4 mg/L in sample G to a high value of 27.3 mg/L in sample D. Chloride ranged from 47.0 mg/L to 51.0 mg/L in sample L and sample H respectively. The level of fluoride did not unduly vary and the lowest was recorded as 0.4 mg/L in sample A and the highest in sample L with a value of 1.0 mg/L. Iron was high in sample F with a value of 2.5 mg/L, while low with 1.1 mg/L in sample H. Magnesium had high value in sample D with 3.3 mg/L and 2.1 mg/L as low value in sample G. The values of nitrates varied only slightly and was high in sample H with a value of 9.5mg/L and low in sample L as 8.1 mg/L. Phosphate was high in sample B with a value of 2.1 mg/L, while it was 1.3 mg/L in sample K as lowest. Potassium was 2.1 mg/L and 1.0 mg;/L as high and low in sample A and sample C and K respectively. Silicate varied from 15.2 mg/L in sample K and 19.4 mg/L in sample B. Sodium was high in sample H with a value of 3.3 mg/L, and low in sample D with a value of 2.1 mg/L. Sulphate ranged from 8.0 mg/L to 9.5 mg/L in sample F and L respectively.

Most of the fresh waters derive their sodium, potassium, calcium, chloride, sulphate and other nutrients from soils and rocks. Phosphate is considered amongst the primary limiting nutrients in ponds and lakes[20]. Phosphate was generally low with a peak in summer season. The higher concentration of it could be from the run-off from the agricultural fields[15]. The main source of the formation of nitrate is the decomposition and biodegradation of organic matters. High nitrates would indicate high pollution load. Intrusion of sewage into the natural water increases levels of nitrate[16]. Nitrate level in the sample is below permissible limits making them suitable for humans and live stock consumption[18].

Conclusion: Among the twelve sampling places of villages at the bank of Krishna river in palus tahasil, all the samples for most of the parameters were found to have their values within the standard values prescribed by WHO and NAFDAC.

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TABLE: 1. The Sample Coding of the villages at the bank of Krishna River in Palus Tahasil

Sr.	Sampling Place	Sample Code	Sr.	Sampling Place	Sample Code	Sr.	Sampling Place	Sample Code
1	Amanapur	**A**	5	Bramhanal	**E**	9	Nagthane	**I**
2	Ankhalkhop	**B**	6	Burli	**F**	10	Punadi	**J**
3	Audumber	**C**	7	Dudhondi	**G**	11	Tavadervadi	**K**
4	Bhilawadi	**D**	8	Nagrale	**H**	12	Tupari	**L**

TABLE: 2. Physico-Chemical parameters and the Nutrients of the Samples **A** to **L**

Sr	**Parameters**	The Sample Codes of the villages at the bank of Krishna River in Palus Tahasil											
A	(mg/L)	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**
1	BOD	**5.3**	5.5	5.8	5.4	5.9	7.8	7.3	**8.1**	6.8	7.0	6.5	6.9
2	COD	110.50	100.50	86.90	81.40	**75.30**	106.30	111.24	97.50	**112.30**	95.70	96.89	84.76
3	Color	clear	clear	clear	clear	clear	clear	clear	clear	clear	clear	clear	clear
4	DO	**3.4**	3.6	4.6	4.9	3.9	5.4	6.1	6.4	5.9	4.8	**6.3**	5.7
5	Dissolved solids	471.55	420.15	475.15	410.80	428.17	**410.20**	501.27	509.13	499.89	480.76	**510.93**	489.10
6	Ele. Con. umho/cms	619	599	**710**	580	637	597	**578**	690	603	704	584	707
7	Total Hardness	21.50	22.41	21.99	**33.89**	21.87	23.12	**20.99**	27.54	26.12	27.18	24.56	25.46
8	Odour	No	No	No	No	No	No	No	No	No	No	No	No
9	P^H	7.8	7.7	7.9	8.1	**8.3**	8.0	7.6	**7.4**	8.2	7.5	**7.4**	7.8
10	Suspended solids	97.6	96.3	96.9	97.3	**94.8**	95.8	**98.1**	95.3	96.7	97.9	94.9	97.4
11	Temp o^0C	**25.4**	**27.9**	27.6	26.7	25.6	25.8	26.2	26.6	26.3	25.7	25.9	26.0
12	Total Solids	539.04	**504.30**	576.20	509.56	544.27	**609.23**	537.59	527.45	601.89	542.87	509.43	510.28
13	Total Alkalinity	167.33	162.42	159.99	164.52	**167.42**	**155.75**	119.45	**115.43**	158.75	160.75	**115.43**	165.72
14	Turbidity(NTU)	19.9	18.4	21.4	**22.3**	20.9	19.3	18.9	17.6	16.3	15.9	21.4	**15.4**
B	**Nutrients (mg/L)**												
15	Calcium	18.9	19.8	26.4	**27.3**	**21.5**	22.8	**18.4**	25.4	24.7	23.5	26.2	20.3
16	Chlorides	49.8	48.3	50.3	47.5	48.9	50.4	47.7	49.2	**51.0**	48.9	49.2	**47.0**
17	Fluorides	**0.4**	0.7	0.6	0.9	0.5	0.9	0.7	0.7	0.6	0.9	0.8	**1.0**
18	Iron	1.4	1.7	2.4	1.9	2.1	**2.5**	1.3	**1.1**	2.3	1.2	2.1	1.5
19	Magnesium	2.9	3.1	2.4	**3.3**	2.9	2.6	**2.1**	2.7	**3.1**	2.8	2.2	3.2
20	Nitrate	8.9	9.2	8.3	9.4	8.7	8.6	8.8	**9.5**	9.0	8.7	9.1	**8.1**
21	Nitrite	0.6	0.4	**0.7**	0.5	**0.3**	0.4	0.5	0.3	0.6	0.5	0.3	0.4
22	Phosphates	1.8	**2.1**	1.9	1.7	1.4	2.0	1.9	1.6	1.4	2.0	**1.3**	1.8
23	Potassium	**2.1**	1.9	**1.1**	1.4	2.0	1.3	1.8	1.2	2.0	1.4	**1.1**	1.5
24	Silicates	15.3	**19.4**	17.2	18.3	16.1	19.1	17.8	16.9	15.8	19.3	**15.2**	17.6
25	Sodium	2.9	3.1	2.6	**2.1**	3.2	2.4	3.0	**3.3**	2.8	2.4	2.7	**3.3**
26	Sulphates	8.7	9.1	9.4	8.6	9.0	**8.0**	8.8	8.5	9.3	9.2	8.4	**9.5**