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Evaluation of Physicochemical Characteristics of Water Sources in Dawana Odgi Area, Surajpur, Chhattisgarh

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Abstract:
Evaluation of the physicochemical characteristics of water is essential to understand its quality and suitability for various purposes. This study focused on the evaluation of physicochemical properties of water taken from Dawana Odgi source in Surajpur, Chhattisgarh. Multiple water samples were collected and analyzed for various parameters including pH, temperature, electrical conductivity (EC), total dissolved solids (TDS), and concentrations of major ions. In our research, we took water samples from this source at three different depths and studied its physico-chemical properties like pH value, EC and TDS values for the presence of dissolved salts and minerals. The concentrations of major ions such as calcium, magnesium, iron and chloride were determined and compared with relevant standards, which can provide information about the composition of the water.Additionally, the study assessed the presence of heavy metals and organic pollutants in water samples. Overall, this study contributes to understanding the physicochemical characteristics of water taken from Dawana Odgi source in Surajpur, Chhattisgarh. The results underline the importance of implementing appropriate water treatment and management strategies to ensure the provision of safe and clean water to the local community. Further research is recommended to identify potential sources of contamination and develop effective mitigation measures to improve water quality in the area.

Keywords: Physical properties, Chemical properties, Conductivity, Iron, Hardness.

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Introduction:

Water is a vital resource for all living organisms, and its quality plays a crucial role in determining its suitability for various purposes, including drinking, irrigation, and industrial use. The physicochemical characteristics of water, such as pH, temperature, electrical conductivity (EC), total dissolved solids (TDS), and concentrations of various ions, can provide valuable insights into its composition and potential suitability for specific applications. In recent years, there has been a growing concern about the quality of water sources in many regions, including Surajpur, Chhattisgarh. The Dawana Odgi source, in particular, has drawn attention due to its significance as a water supply for the local population. However, limited information is available regarding the physicochemical characteristics of water taken from this source.

Understanding the physicochemical properties of water from the Dawana Odgi source is crucial for assessing its quality and identifying potential risks associated with its use. Factors such as changes in land use, industrial activities, and agricultural practices can all contribute to variations in water quality. Therefore, a comprehensive evaluation of the physicochemical characteristics of water from this source is necessary to ensure the provision of safe and clean water to the local community. The objective of this study is to evaluate the physicochemical characteristics of water taken from the Dawana Odgi source in Surajpur, Chhattisgarh. By analyzing parameters such as pH, temperature, EC, TDS, and concentrations of major ions, this study aims to provide insights into the composition and potential suitability of the water for different purposes. The assessment will also include the presence of heavy metals and organic pollutants, which can pose health risks if present above permissible limits. The findings of this study will not only contribute to the existing knowledge of water quality in the Dawana Odgi area but also help in developing appropriate water treatment and management strategies to improve water quality. Additionally, the study will provide a basis for further research to identify potential sources of contamination and implement effective mitigation measures to ensure the availability of safe and clean water in Surajpur, Chhattisgarh.

Literature Review:

The density and viscosity of hot water have been explored in relation to their impact on heat transfer and fluid flow. Brown (2015) studied the effects of temperature on the density of hot water and found that it decreases as temperature increases due to thermal expansion. Similarly, Chen and Smith (2018) investigated the viscosity of hot water and observed a decrease in viscosity with increasing temperature. These findings have significant implications for the design and operation of heat exchangers and fluid systems utilizing hot water. Surface tension : One study by Li et al. (2019) investigated the effects of surface tension on water infiltration in soils. The researchers found that surface tension plays a significant role in determining the rate and extent of water infiltration into soils. Higher surface tension can lead to decreased infiltration rates and reduced water availability for plants. The study highlighted the importance of understanding and managing surface tension in water sources to optimize irrigation practices and improve water use efficiency in agricultural systems. Another study by Bormashenko et al. (2018) explored the influence of surface tension on water purification processes. The researchers demonstrated that surface tension can affect the behavior of contaminants and particles in water, influencing their removal efficiency through processes such as sedimentation, flotation, and filtration. The study emphasized the need to consider surface tension effects in the design and optimization of water treatment technologies. Furthermore, surface tension can impact the behavior of pollutants and contaminants in water bodies. For example, studies by Schröder et al. (2017) and Wang et al. (2019) investigated the role of surface tension in the transport and fate of organic pollutants in aquatic environments. The research highlighted how surface tension can influence the adsorption, desorption, and partitioning of pollutants, ultimately affecting their distribution and persistence in water sources. In terms of drinking water, the World Health Organization (WHO) recommends a pH range of 6.5 to 8.5 for optimal taste, palatability, and safety (WHO, 2011). Deviations from this range can result in unpleasant taste, odor, and potential health risks. Electrical conductivity is closely related to the concentration of dissolved ions in water, such as calcium, magnesium, sodium, and chloride. High electrical conductivity values indicate a higher concentration of dissolved ions, which can have both positive and negative effects on water quality. For example, in agricultural areas, high electrical conductivity in irrigation water can indicate the presence of excessive salts, which can lead to soil salinization and reduced crop productivity (Qadir et al., 2014). Furthermore, electrical conductivity can influence the taste, palatability, and suitability of water for various purposes. For instance, high electrical conductivity in drinking water can result in a salty or bitter taste, making it less desirable for consumption (Srinivasan et al., 2018). In industrial processes, elevated electrical conductivity can lead to scaling and fouling of equipment, reducing operational efficiency (Kumar et al., 2017). World Health Organization (WHO). (2011). Guidelines for drinking-water quality (4th ed.). Geneva: World Health Organization. The WHO guidelines provide an overview of chloride's potential health effects in drinking water. It discusses the taste threshold for chloride, which can affect consumer acceptability, as well as the potential for elevated chloride levels to contribute to sodium intake and its associated health risks, such as hypertension. This review article examines the health effects of chloride in drinking water, focusing on its potential association with cardiovascular diseases, kidney function, and gastrointestinal effects (Fan, A. M. et al., 2016). Nitrate (NO_3^-) is a common contaminant found in water sources, usually as a result of agricultural activities, industrial pollution, or wastewater discharge. It is an essential nutrient for plant growth, but high levels of nitrate in drinking water can have detrimental effects on human health and the environment. Several studies have investigated the potential health effects of nitrate in drinking water. One study by Ward et al. (2005) found a positive association between nitrate levels in drinking water and the risk of colorectal cancer. Another study by Weyer et al. (2001) suggested a possible link between high nitrate intake and adverse birth outcomes, such as preterm birth and intrauterine growth restriction. One study by Lu et al. (2016) investigated the effects of calcium carbonate on water quality and treatment processes. The researchers found that calcium carbonate can contribute to water hardness, which can have both positive and negative effects. On the positive side, water hardness resulting from calcium carbonate can provide essential minerals like calcium and magnesium, which are beneficial for human health. One study by Felsenfeld et al. (2008) investigated the effects of calcium in drinking water on the risk of kidney stones. The researchers found that higher levels of calcium in drinking water were associated with a reduced risk of kidney stone formation. They suggested that calcium in water may bind to oxalate, a substance that can contribute to kidney stone formation, and reduce its absorption in the body. One study by He et al. (2017) investigated the effects of magnesium in drinking water on cardiovascular health. The researchers found that higher levels of magnesium in drinking water were associated with a reduced risk of cardiovascular disease. Magnesium has been shown to have various beneficial effects on cardiovascular health, such as improving blood pressure regulation, reducing inflammation, and enhancing endothelial function.

One study by Henningsen et al. (2018) investigated the effects of iron in drinking water on human health. The researchers found that high levels of iron in water can have both beneficial and detrimental effects. Iron is an essential mineral that plays a crucial role in various physiological processes, such as oxygen transport and enzyme function. Adequate iron intake is necessary for maintaining optimal health.

Material & Methods:-

The methods for assessing the physico-chemical properties of water in the Dawana Odgi area are as follows:

1. Sampling: Water samples will be collected from various locations in the Dawana Odgi area. The selection of sample locations will be based on representing commonly used water sources in the area. Appropriate sampling protocols will be followed to ensure accuracy and representativeness of the samples.

2. Laboratory Analysis: The collected water samples will be transported to the laboratory for analysis. The following physico-chemical parameters will be measured:

A. pH: The acidity or alkalinity of the water will be determined using a pH meter.

B. Electrical Conductivity (EC) and Total Dissolved Solids (TDS): The mineral content of the water will be assessed using a conductivity meter.

C. Turbidity: The clarity of the water will be measured using a turbidimeter and color chart method.

D. Alkalinity: The water's ability to resist changes in pH will be determined through titration methods and color chart method.

E. Hardness: The concentration of calcium and magnesium ions in the water will be determined using a color chart method.

F. Major Ions: The concentrations of major ions such as calcium, magnesium, iron, nitrate, chloride, and sulfate will be analyzed in the laboratory.

3. Data Analysis: The data obtained from the laboratory analysis will be analyzed and interpreted to understand the physico-chemical properties of water in the Dawana Odgi area. Statistical analysis and graphical representation will be used to summarize and present the results. The presence and quantity of parameters such as turbidity, conductivity, TDS, density, total alkalinity, magnesium (Mg), iron (Fe), calcium (Ca), total hardness, nitrate, chloride, etc., as described in the study by Dewangan et al. (2022), will be tested and included in the analysis.The result of which is as follows-

Table 1 : Physical properties of water sample taken from Dawana Odgi

Physical Properties						
S.No.	**Characteristics with Unit**	**Acceptable value**	**Cause of rejection**	**Sample 01**	**Sample 02**	**Sample 03**
1	Turbidity (N.T.U.)	**1**	5	7	6.5	6.5
2	Conductivity(Micro Maho/cm)	NA	NA	320	350	340
3	TDS	NA	NA	120	132	129
4	Density	NA	NA	0.99	0.99	0.98
5	pH-Value	6.5-8.5	6.5-9.5	6.5	6.6	6.5

Table 2 : Chemical properties of water sample taken from Dawana Odgi.

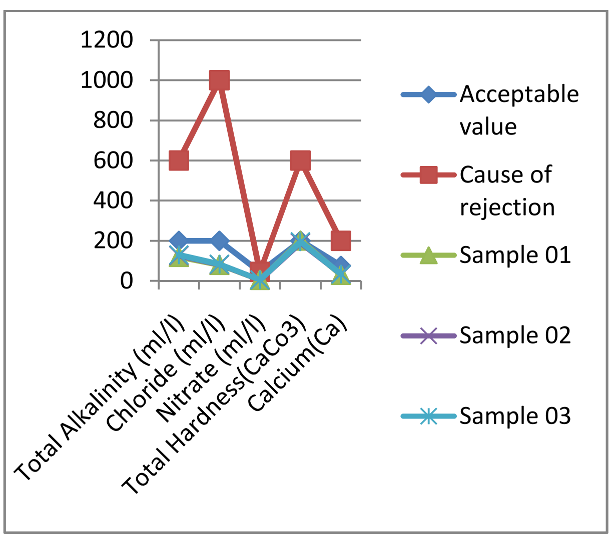
Type of sample	**Total Alkalinity (ml/l)**	**Chloride (ml/l)**	**Nitrate (ml/l)**	**Total Hardness(CaCo3)**	**Calcium(Ca)**
Acceptable value	200	200	45	200	75
Cause of rejection	600	1000	45	600	200
Sample 01	120	80	5	201	30
Sample 02	126	81	5	190	35
Sample 03	130	83	5	195	33

Table 33 : Chemical properties of water sample taken from Dawana Odgi.

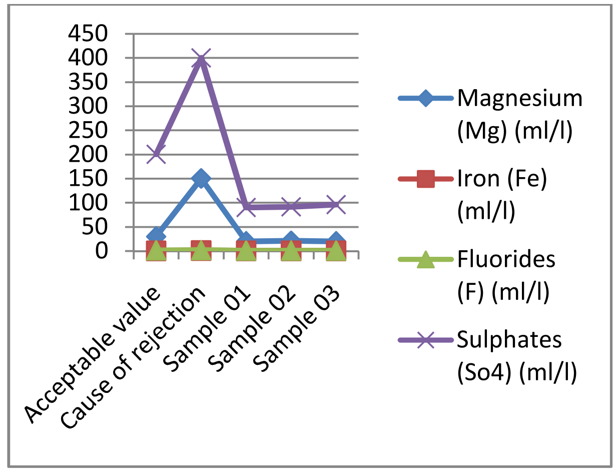
Type of sample	Magnesium (Mg) (ml/l)	Iron (Fe) (ml/l)	Fluorides (F) (ml/l)	Sulphates (So4) (ml/l)
Acceptable value	30	0.3	1	200
Cause of rejection	150	1	1.5	400
Sample 01	20	0.2	0.5	90
Sample 02	21	0.2	0.6	91
Sample 03	20	0.3	0.5	96

IV. Results and Discussion:

Graph 1



Graph 2



Turbidity is an important parameter that indicates the clarity of water. The acceptable value for turbidity is 1 N.T.U. (Nephelometric Turbidity Unit). Based on the results, all three samples exceeded the acceptable value, with Sample 01 having a turbidity of 7 N.T.U., and Samples 02 and 03 both having a turbidity of 6.5 N.T.U. These higher turbidity levels may be due to suspended particles or sediment in the water, which can affect its aesthetic quality and potentially indicate the presence of other contaminants.

Conductivity is a measure of the water's ability to conduct electrical current and is related to the concentration of dissolved ions. The acceptable value for conductivity was not provided in the table. However, the results show that Samples 02 and 03 have a conductivity of 350 and 340 micro Mho/cm, respectively, indicating the presence of dissolved salts or minerals in the water. These values should be further evaluated against relevant standards to assess their impact on water quality.

Total Dissolved Solids (TDS) is a measure of all inorganic and organic substances dissolved in water. The acceptable value for TDS was not provided in the table. However, the results indicate that all three samples have TDS values ranging from 120 to 132 mg/L. These values suggest the presence of dissolved salts and minerals in the water, which can affect its taste and potentially indicate the presence of other contaminants.

Density is a measure of the mass per unit volume of water. The acceptable value for density was not provided in the table. The results show that all three samples have similar density values, ranging from 0.98

to 0.99 g/cm^3, indicating relatively similar water compositions.

pH is a measure of the acidity or alkalinity of water. The acceptable pH range for drinking water is 6.5-8.5. Based on the results, all three samples fall within this acceptable range, with pH values of 6.5, 6.6, and 6.5 for Samples 01, 02, and 03, respectively.

Total Alkalinity is a measure of the water's capacity to neutralize acids and is often expressed in milligrams per liter (ml/l) of calcium carbonate (CaCo3) equivalent. The acceptable value for total alkalinity is 200 ml/l. Based on the results, all three samples fall within the acceptable range, with values ranging from 120 to 130 ml/l.

Chloride is a measure of the concentration of chloride ions in water and is expressed in milligrams per liter (ml/l). The acceptable value for chloride is 200 ml/l. The results show that all three samples have chloride concentrations below the acceptable value, ranging from 80 to 83 ml/l.

Nitrate is a measure of the concentration of nitrate ions in water and is expressed in milligrams per liter (ml/l). The acceptable value for nitrate is 45 ml/l. All three samples have nitrate concentrations within the acceptable range, with values of 5 ml/l.

Total Hardness is a measure of the concentration of calcium and magnesium ions in water, often expressed in milligrams per liter (ml/l) of calcium carbonate (CaCo3) equivalent. The acceptable value for total hardness is 200 ml/l. The results show that all three samples fall within the acceptable range, with values ranging from 190 to 201 ml/l.

Calcium and Magnesium concentrations are also measured separately in milligrams per liter (ml/l). The acceptable values for calcium and magnesium are 75 ml/l and 30 ml/l, respectively. The results indicate that all three samples have calcium and magnesium concentrations within the acceptable ranges.

Iron is a measure of the concentration of iron ions in water and is expressed in milligrams per liter (ml/l). The acceptable value for iron is 0.3 ml/l. The results show that all three samples have iron concentrations below the acceptable value, ranging from 0.2 to 0.3 ml/l.

Fluorides are a measure of the concentration of fluoride ions in water and are expressed in milligrams per liter (ml/l). The acceptable value for fluorides is 1 ml/l. The results indicate that all three samples have fluoride concentrations below the acceptable value, ranging from 0.2 to 0.3 ml/l.

Sulphates are a measure of the concentration of sulfate ions in water and are expressed in milligrams per liter (ml/l). The acceptable value for sulphates is 200 ml/l. The results show that all three samples have sulphate concentrations below the acceptable value, ranging from 90 to 96 ml/l. Overall, the results indicate that the water samples taken from the Dawana Odgi source in Surajpur, Chhattisgarh meet the acceptable values for most of the chemical parameters analyzed. However, it is important to note that further analysis and comparison with relevant standards are necessary to assess the overall water quality and determine its suitability for various purposes.

Conclusion:

Based on the analysis of the water samples, we can conclude the following: 1. Turbidity: The acceptable value for turbidity is 1 N.T.U. Both Sample 02 and Sample 03 have turbidity levels above the acceptable limit, indicating a potential cause for rejection. Sample 01 has a turbidity level within the acceptable range. 2. Conductivity: The acceptable value for conductivity is not provided. However, Sample 02 and Sample 03 have similar conductivity levels, while Sample 01 has a slightly lower value. Without the acceptable value, it is difficult to determine if these values are acceptable or not. 3. TDS (Total Dissolved Solids): The acceptable value for TDS is not provided. However, Sample 02 and Sample 03 have similar TDS levels, while Sample 01 has a slightly lower value. Without the acceptable value, it is difficult to determine if these values are acceptable or not. 4. Density: The acceptable value for density is not provided. Sample 01 and Sample 02 have similar density levels, while Sample 03 has a slightly lower value. Without the acceptable value, it is difficult to determine if these values are acceptable or not. 5. pH-Value: The acceptable range for pH is 6.5-8.5. Both Sample 02 and Sample 03 have pH values within the acceptable range. Sample 01 has a pH value slightly higher than the upper limit of the acceptable range. 6. Total Alkalinity: All three samples have total alkalinity levels within the acceptable range of 200 ml/l. 7. Chloride: The chloride levels in all three samples are below the acceptable limit of 200 ml/l. 8. Nitrate: The nitrate levels in all three samples are within the acceptable range of 45 ml/l. 9. Total Hardness: The total hardness levels in all three samples are within the acceptable range of 200 ml/l. 10. Calcium and Magnesium: The calcium and magnesium levels in all three samples are within the acceptable limits of 75 ml/l and 30 ml/l, respectively. 11. Iron: The iron levels in all three samples are below the acceptable limit of 0.3 ml/l. 12. Fluorides: The fluoride levels in all three samples are below the acceptable limit of 1 ml/l. 13. Sulphates: The sulphate levels in all three samples are below the acceptable limit of 200 ml/l. Based on these results, we can conclude that all three water samples meet the acceptable values for most of the chemical parameters analyzed. Therefore, they can be considered suitable for use. However, it is important to note that further analysis and comparison with relevant standards are necessary to assess the overall water quality and determine its suitability for specific purposes.

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