Original Research Article

ASSESSMENT OF THE PHYSICO-CHEMICAL PROPERTIES OF WATER SAMPLES COLLECTED FOR FOUR DIFFERENT SAMPLES AT RAMNAD AND SIVAGANGAI DISTRICTS, TAMIL NADU, IN INDIA

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Abstract

Four brands of sachet packaged water samples were collected in and around Ramnad and Sivagangai district, People use polluted water which causes many health problems and therefore people must be educated to remove impurities from water. The present study was carried out to determine the physico-chemical quality of 4 brands of packaged drinking water available at two different regions and compared with Bureau of Indian Standards Specifications (BIS). The results of the analyses revealed that most of the water samples were colourless, odourless. The chemical analysis showed that the measured parameters are in the range: pH (8.3-9.1); electrical conductance - EC (0.11-1.1 unit); alkalinity (0.6-1.0 mg/l); total hardness - TH (18.5-35.0 mg/l); calcium hardness (20.0-23.75 mg/l); magnesium hardness (3.5-11.75 mg/l); dissolved oxygen - DO (5.2-9.2 mg/l); chemical oxygen demand - COD (0.25-0.38 mg/l); chloride as Cl^- (15.9-24.25 mg/l); sulphate (20.63-27.5 mg/l). It can be noticed that the concentration of the investigated parameters in the analysed water samples were within the permissible limits of the bureau of Indian standard (BIS) drinking water quality guidelines except for the values of pH and DO. The pH values for sample B, C and D which is also above the permissible limits as prescribed by BIS.

Keywords: Packaged drinking water, physico-chemical parameter; BIS-specification; chemical oxygen demand (COD); dissolved oxygen (DO).

1. Introduction

Water is a universal solvent & it exist in three states – solid, liquid & vapour [1].It is needless to emphasise the importance of water in our life. We need water for different purposes such as dinking, irrigation, industries, swimming, fishing etc.

Thus water for different purposes has its own requirements in terms of composition and purity as well as the presence of different components in water has to be analyzed on a regular basis to confirm its suitability. Environmentally, water is so important that its pollution becomes a serious problem, since it affects the lives of many populations throughout the world [2].

Natural water contains different types of impurities due to increased human population, industrialization, use of fertilizers in the agriculture and human activities. Water is highly polluted with different harmful contaminants [3]. Also, aquatic system becomes impure by different ways such as, earth crust temperature, soil erosion and from several human activities [3]. The contamination or pollutants in natural water can be microbial and chemical in origin [2].

Microbial contaminants in the drinking water affect human health more than chemical contaminants because it doesn't require long term exposure whereas the latter require long term exposure [4]. Nonetheless, chemicals in water supplies can cause very serious problem [4]. Two millions of children's death occurs every year due to contaminated water [5].

Safe drinking water is a basic need for human development, health and well being; it is internationally accepted by human rights [4]. In the world, about 1.1 billion of population doesn't have access to improved water supply,

while 2.4 billion do not have access to improved sanitation facility [2].

Almost 50% of the population in the developing countries is suffering from water borne illness [7,8] adding to that 1.8 million of children die from diarrhea each year and 443 million school days are lost due to water related illness [7].

Therefore the packaged drinking water is preferred and highly demanded in many parts of the country. But the quality of the most packaged waters can't be believable one [2]. Water in sachet is readily available and affordable but there are some serious concerns about its purity [9].

Packaged water is defined as any potable water processed and offered for sale in sealed food grade bottles or other appropriate containers for human consumption. Bottle or sachet water like any other food product, must be processed and packaged under aseptic conditions. Contaminants or impurity are also introduced during manufacturing and consumer handling [4].

For example, in Nigeria, the government claims that it is their duty to provide potable water to their citizens through government owned public water utilities. The supplied water should be free from disease producing chemical and microbial substances that are dangerous to health [8]. The supply of water by these utilities is grossly inadequate both qualitatively and quantitatively. Because of deficiency of water supply by government, the private sector water supply is increased and the idea of packaged drinking water popularly referred to as "pure water" is now a common phenomenon in the country [11].

Access to adequate supply of safe drinking water for all the population is one of the primary goals of the world health organization - WHO [13]. Polyethene packaged water (pure water) has been widely consumed in the rural area across Nigeria [8].

This work has been carried out to determine portable quality of water collected from different packaged drinking water sold in

Ramnad and Sivagangai Districts, Tamil Nadu, in India areas. The experimental data are checked to know, how the characters differ from one source to another by comparing with Bureau of Indian Standards specifications (BIS).

2. Materials and Methods

Samples of packaged drinking water which were collected from Ramnad and Sivagangai Districts, Tamil Nadu in India are: Sample A, Sample B, Sample C and Sample D. Samples were refrigerated at 4°C and analyzed within 24 hours of collection [4,7]. The pH was determined using modern digital pH-meter [9] after the meter was calibrated with standard buffers of pH 4.0, 7.0 [1,10,11,13,14]. Sample A and B were collected from Ramnad Districts and Sample B and C were collected from Sivagangai Districts, Tamil Nadu, in India.

Alkalinity was determined by titration method with corresponding indicator [12]. Chloride was measured by precipitation method [3]. EDTA titration method was used for the determination of the Total Hardness (TH) as well as calcium and magnesium hardness [1, 9]. Dissolved oxygen (DO) was determined by the modified Winkler's method [3, 13]. Chemical oxygen demand (COD) was carried out by using titration method whereas; the sulphate was determined by turbid metric method [3, 12]. The electrical conductance (EC) was found out by E.C. meters [3, 10, 12, 14].

3. Results and Discussion

Physico-Chemical properties of the four different water samples are shown in Table 1. All the samples are found to be colorless and odorless; Sample A and Sample B were collected from Ramnad and Sample C and Sample D were collected from Sivagangai districts, Tamil Nadu, in India.

3.1. pH Parameter

The overall pH value ranges from 8.3 to 9.1 except samples B, C and D. This range is higher than BIS range and fall outside of the acceptable values [4]. However, Sample A falls within BIS range and its value is within the permissible limit of pH in the water; 6.5 to 8.5 (ISI). According to WHO, the recommended pH range for drinking water is settled between 6.5 and 8.5 (2007) [5], the higher value of pH will have serious effects on human health. Additionally, the pH is the most important in determining the corrosive nature of water [3]. According to literature [4], one of the sachet water (E) having the highest pH (7.47) [8,9].

3.2 Electrical Conductance (EC)

The Measurement of EC is used to determine the presence of ions in aqueous solution. Higher value of conductivity indicates higher concentration of dissolved ions. The EC for the four water samples ranges between 0.11 and 0.34 mho, which falls within the BIS range. The EC values of these samples were below the standard value and did not contain much ionized metals especially those that could pose serious health hazards [2]. Among these 4 results, the values are arranged in the following ascending order:

Sample A> Sample D> Sample B> Sample C
(1.1 mho) (0.34 mho) (0.15 mho) (0.11 mho)

3.3 Alkalinity

Alkalinity refers to the capability of water to neutralize acid, which is really an expression of buffering capacity. The value of alkalinity for the four water samples is 0.7, 1.0, 0.6 and 0.7 mg for A, B, C and D respectively. All values fall within BIS range as well as the permissible limit [4,15].

3.4 Total Hardness (TH)

TH indicates or represents the amount of Ca^{2+} and Mg^{2+} ions present in the sample. It is expressed as $CaCO_3$. The desirable limit for TH is 300 mg/l in potable water as per BIS. TH value for the four water samples varies from 16.0 up to 37.5 mg/l, which falls within BIS range. The water containing excess hardness is not advisable for drinking purpose and also not desirable for even domestic purpose. The analyzed samples indicated that they are all soft [15].

3.5 Calcium and Magnesium

The calcium is an essential constituent for human being. The low content of Ca^{2+} in drinking water may cause rickets, defective health, and also, it is essential for neuro-system. The calcium hardness of the four water samples is between 22.0 and 23.75 mg/l. The BIS value for Ca^{2+} hardness is 200 mg/l, indicating that all water samples have much lower value of Ca^{2+} than the permissible limit.

Similarly, the magnesium hardness of the four water samples is 3.5, 11.75, 11.5 and 10.0 mg/l. The permissible mg-content in drinking water according to BIS is 100 mg/l, thus indicating that all the analysed 4 water samples possess values that fall much lower than BIS standard.

The value of Ca^2+ and Mg^{2+} hardness of the four water samples was much higher than the WHO standard but that was suitable and within the BIS Standard (Specification) [15].

3.6 Dissolved Oxygen (DO)

The amount of oxygen present in the drinking water was determined by DO. All the four water samples have DO property in it. The BIS range for drinking water ranges from 4 to 6 mg/l. The DO measured values are: Sample A (8.24 mg/l), Samples B and D (9.2 mg/l) which are extremely higher than BIS range (4–6 mg/l). Only sample C has a DO value within BIS range; 5.2 mg/l.

3.7 Chemical Oxygen Demand (COD)

COD represents the best method to measure the amount of dissolved oxidisable organic matter and also non – biodegradable matters present in it. The tested samples have COD ranging between 0.25 and 0.38, which are very much lower than BIS range [5].

3.8 Chloride

Chloride is one of the major inorganic anion in water. The permissible limit of chloride in water is 250 mg/l as per BIS. The chloride content of the tested water samples is: Sample A (24.25 mg/l), Sample B (21.63 mg/l), Sample C (15.9 mg/l) and Sample D (21.0 mg/l). These values are higher than the standards of BIS value (4 mg/l), which is unfortunately undesirable. It is very important to mention that higher chorine concentration gives an undesirable salty taste to water [13,14].

3.9 Sulphate

Sulphate is widely distributed as magnesium sulphate. The sulphate content of water samples is: Sample A (27.5), Sample B (24.75), Sample C (20.63) and Sample (25.75). The BIS range of sulphate in drinking water is set in the range 200-400 mg/l and all the analysed water samples which fall within it. According to the literature [6,16], the sulphate content in samples was lower than permissible limit. Finally, the results of this work are explained in graphical representation, see Figures 1 and 2.

4. Conclusion

This study gives an insight of major quality constituents of four packed water brands sold in Ramnad and Sivagangai Districts, Tamil Nadu in India. The measured constituents in brands are within standards limit set by BIS. Except the parameter like pH for samples B, C, D and DO for A, B, D were slightly more than the permissible limits of BIS specification. However the physic-chemical quality of the brands studied was variable, which possibly depends on many factors such as types of treatment/purification technique applied during the production, storage and transportation especially when exposed to direct sunlight.

The study suggested that, the packaged drinking water is not necessarily safer than tap water and consumers should be aware. Regular assessment of the above mentioned parameters would be helpful to improve water quality and avoid serious health issues.
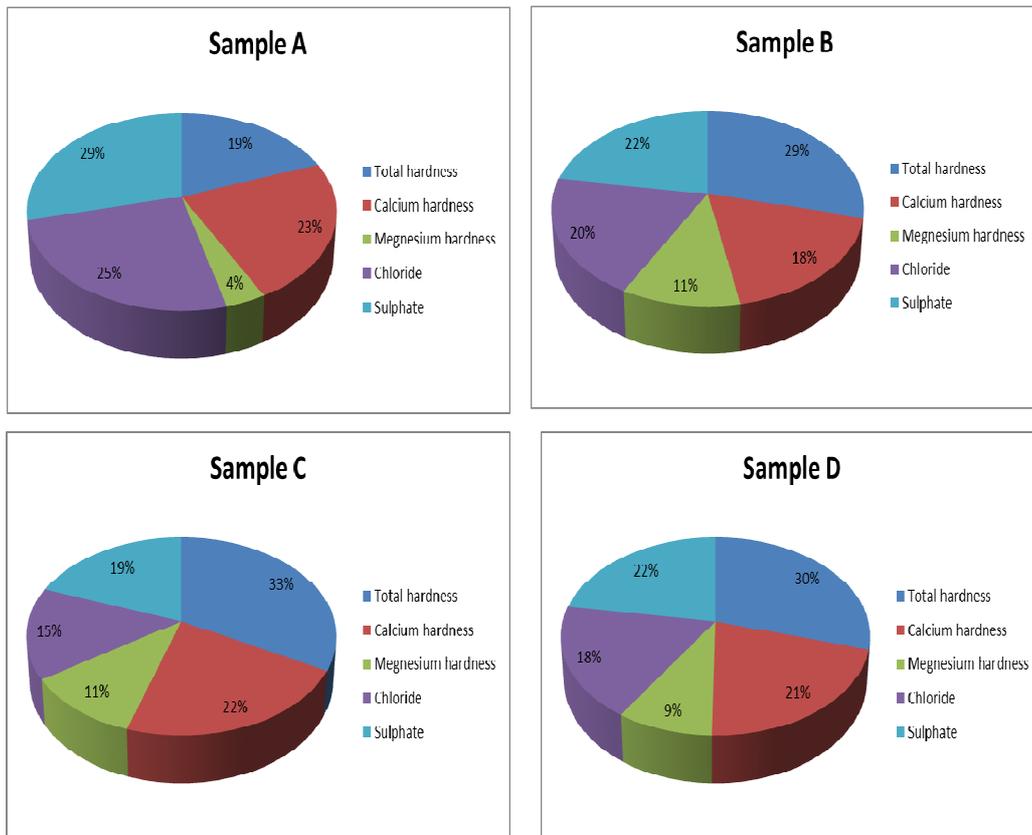
Figure 1. The Physico-Chemical parameters of the selected packaged water samples A, B, C and D
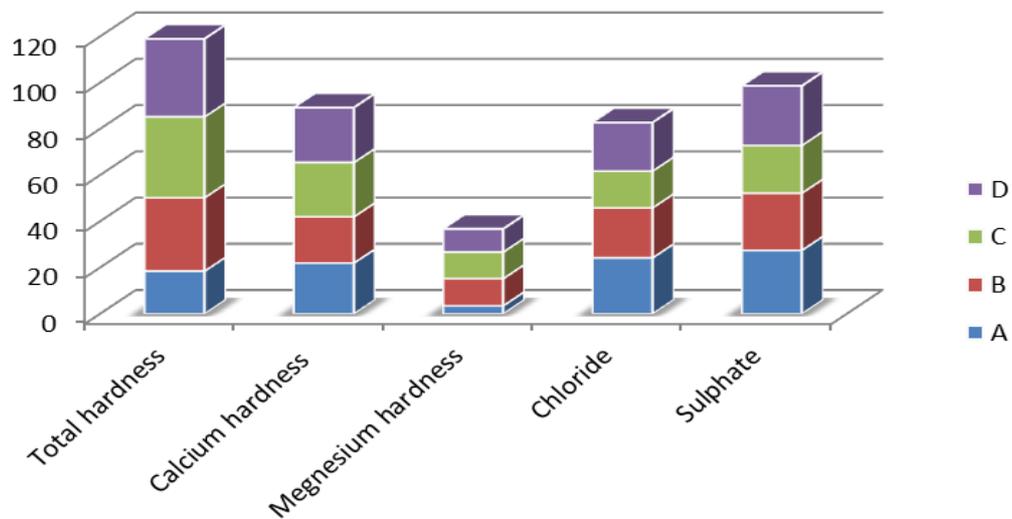

Figure 2. The Physico-Chemical parameters of the selected packaged water samples A, B, C and D

Table 1. Physico-chemical parameters of the selected packaged water samples

S.No.	Samples	PARAMETERS									
		pH	EC (mho)	Alkalinity (mg/l)	Total Hardness (mg/l)	Calcium Hardness mg/l	Magnesium Hardness (mg/l)	DO (mg/l)	COD (mg/l)	Chloride (mg/l)	Sulphate (mg/l)
1	Sample A	8.3	1.1	0.7	18.5	22.0	3.5	8.24	0.25	24.25	27.5
2	Sample B	8.8	0.15	1.0	31.75	20.0	11.75	9.2	0.38	21.63	24.75
3	Sample C	8.8	0.11	0.6	35.0	23.5	11.5	5.2	0.34	15.9	20.63
4	Sample D	9.1	0.34	0.7	33.75	23.75	10.0	9.2	0.29	21.0	25.75
	BIS Range	6.5, 8.5	222 – 385		300	200	100	4.0 – 6.0	250	4	200 – 400

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