Study of Physicochemical Properties of Commercial Drinking Bottled Water Brands

by Abdul Rehman Jatoi

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Abstract—**Drinking water quality is being affected by industrial effluents, pesticides and fertilizer use in agriculture, poor sanitation services and unhygienic practices. Thus, upper and middle class people used to prefer bottled water for drinking purpose instead of tap water. Increasing demand of bottled water leads to selling out of low quality branded waters in the market due to imperfect check and balance. In this regard, this study is carried out to assess the physicochemical properties of various branded bottled waters. For that, different water brand samples were collected from Safoora Goth Karachi. Various physicochemical quality parameters of branded water samples were analyzed according to the set procedures of American Society for Testing and Materials. It was discovered that the pH level of S9 and S8 bottled water brand were slightly less than World Health Organization guideline values. However, other physical and chemical quality parameters of S1, S2, S4, S5, S7 and S10 branded bottled water samples were found within standards.**

Keywords-drinking water; bottled water; physicochemical properties; contamination

I. INTRODUCTION

Water is considered a key prerequisite for sustention of life. Sufficient quantity of clean & safe water is crucial to human health [1-3]. However, there is severe stress not only on the quantity of available water resources but also on its quality due to population growth, rapid urbanization, industrialization, changing lifestyles and economic development [4, 5]. Water resources are being contaminated by different physical, chemical and biological agents. Its quality control is essential for preservation of environment as well as for protection of public health [6]. Increasing rate of pollution in fresh water resources amplified the demand of bottled waters. The major causes of bottled water demand includes the ambiguity of tap water quality, unavailability of potable water, marketing tactics, the custom of lifestyle, and public awareness [7]. Bottle water consumption has significantly increased since last three decades, particularly in food and beverages industries with an annual average of 12 % in spite of its high cost [8]. Its annual average consumption is more than 100 liters per person in fifteen countries, and over 200 liters per person in Mexico, Italy, and the United Arab Emirates [7]. It is reported that bottle water utilization has been increased enormously in Pakistan i.e. approximately from 6-10 % from 2003 to 2007. It may be due to accessibility, safety, quality, good taste, convenience and lower level of impurities [9-12]. Karachi is the biggest urban center and mega city of Pakistan having population of more than 16 million [13, 14]. Upper and middle class people used to prefer bottled water for drinking purpose instead of using tap water as it is considered to be free from contaminants [1, 11, 12, 15,16]. Although, it is prerequisite to register bottled water brands for quality production in Pakistan, nevertheless the replica and inferior brands are posing serious threat to the public health. Its high demand leads to selling out of low quality brands in the market [17, 18]. The present study is an attempt to investigate on the physicochemical quality parameters of different branded bottled waters, commonly consumed by the people of the Karachi city, Pakistan.

II. MATERIALS AND METHODS

Local brand bottle water samples (around 10) were taken from different shops & supermarkets of Safoora Goth during

the months from September to October. Five samples of each brand were examined in the laboratory, and then the results are displayed in average. The collected sample brands were assigned codes from S1 to S10. These codes were assigned for recognition of water samples during and after analysis. Thermo-set containers were used 5 preserve the samples at 25°C [19-21] and brought to the laboratory for physicochemical analysis. The drinking quality parameters examined in the laboratory are pH, TDS, EC, salinity, alkalinity, chlorides, hardness, turbidity, color, nitrates & fluorides. The pH meter, gravimetric method, floating glass hydrometer, & HI98302 meter were used to analyze pH, TDS, salinity and EC parameters respectively. The titration method was employed for alkalinity, total hardness and chlorides measurements. Turbidity was measured using Nephelometer (Turbidimeter), Color by Platinum-Cobalt Method and Nitrates with Phenol Disulphuric Acid Method. Fluorides content in bottled water was tested with Spectrometer.

III.   RESULTS AND DISCUSSIONS

All samples were examined according to defined procedure of ASTM and compared with WHO standards.

A. Turbidity, Colour and pH

The turbidity level and color of all examined branded bottled water samples were found within permissible limits. The level of pH in examined water samples is shown in Figure 1. Maximum pH value of 8.21 was found in S3 and minimum from S9 brand with 6.1. The second and third maximum values were discovered from S1 and S4 brands with 7.76 and 7.74 respectively. The second and third minimum values were found 6.2 and 6.5 from S8 and S6 brands respectively as compared to all analyzed samples. Furthermore, the analyzed pH values of S2 were 7.5, S10 with 6.9 and both S5 and S7 brand were 6.8.

B. TDS & EC

The values of total dissolved solids (TDS) samples are given in Figure 2. The maximum TDS of 383mg/l was found in S9 and minimum 156mg/l from S1 and S2. The second and third maximum values of TDS were found in S5 and S6 brands with 360mg/l and 352mg/l respectively. The second and third minimum values were found 196mg/l and 228mg/l from S4 and S3 respectively. Furthermore, the analyzed TDS values of S10 were 275mg/l, S8 270mg/l and S7 brand 280mg/l. Besides total dissolved solids, the results of electrical conductivity are given in Figure 3. The maximum electrical conductivity value was found in S5 with 490µS/cm and minimum from S1 with 333µS/cm. The second maximum values were found in S6 with 485µS/cm. S2 and S8 water samples showed second and third minimum values with 347µS/cm and 409µS/cm respectively. Moreover, the analyzed electrical conductivity of S9 were 435µS/cm, S4 417µS/cm and S10 brand were 410µS/cm. The electrical conductivity (EC) of all samples was found within WHO allowable limit of 2500µS/cm.
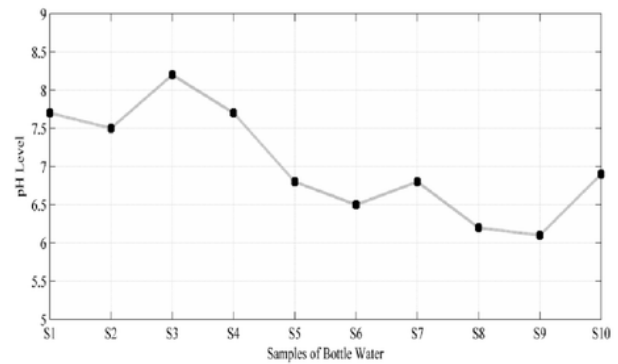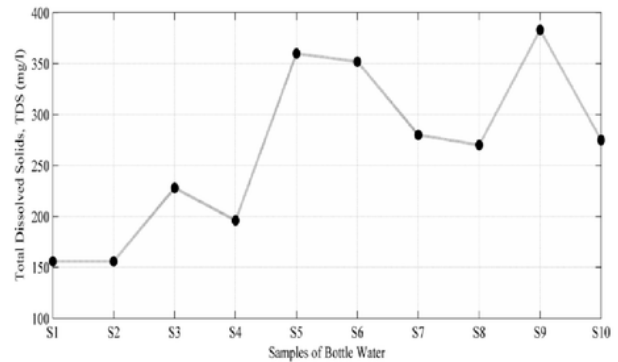

Fig-1   Level of pH in bottled water samples

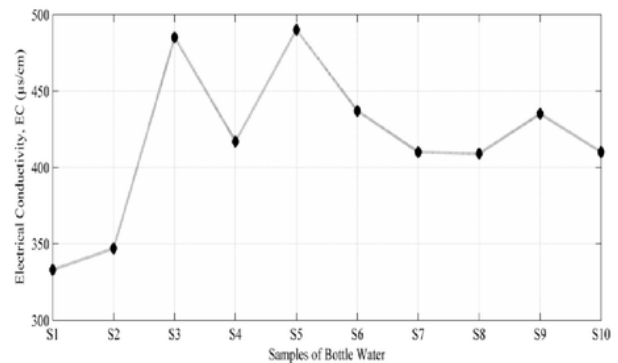Fig-2   Level of total dissolved solids in local brand samples

Fig-3   Level of electrical conductivity in local brand samples

C. Salinity, Alkalinity and Hardness

Figure 4 displayed the analyzed values of salinity. Three brands namely S5, S6 and S7 displayed the maximum salinity of 0.3% in the samples. The minimum concentrations of salinity were found in S1, S2, S3, S4, S8, S9 and S10 with 0.2%. Moreover, the maximum alkalinity of 120mg/l was found in S2 and minimum 53mg/l from S8 as shown in Figure 5. The second and third maximum values were found in S10 and S9 brands with 96mg/l and 82mg/l respectively. Similarly, the maximum level of hardness with 103mg/l was found in S8 and minimum 33.25mg/l in S1 brand as shown in Figure 6. The second and third maximum values were demonstrated from S9

and S5 brand samples with 97mg/l and 95mg/l respectively. The second and third minimum values were found 47.5mg/l and 55mg/l in S2 and S3 brands respectively. The results of hardness in all water samples were within WHO guideline value of < 500mg/l.

D. Chloride, Fluoride and Nitrates

In addition, the results of chlorides are displayed in Figure 7. The maximum chloride value of 130mg/l was found in S5 and minimum 42.54mg/l in S1 brand. The second and third maximum values were noted from S6 and S10 brands with 126mg/l and 107mg/l respectively. The second and third minimum values were found 60.9mg/l and 79.4mg/l from S2 and S3 brand respectively. In addition, the level of fluoride in water samples is shown in Figure 8. The maximum fluoride value was found 0.9mg/l in S3 and minimum from three samples viz, S1, S7 and S8 brands with 0.2mg/l. The fluoride in S5 was found to be 0.5mg/l and both S6 and S9 showed 0.4mg/l. Likewise, Figure 9 demonstrates the values of nitrates in the samples. The maximum 21mg/l of nitrate was found in S6 and minimum 0.6mg/l from S1 brand. The second and third maximum values were displayed by S8 and S10 brand samples with 19mg/l and17mg/l respectively. The second and third minimum values of nitrates were found 0.9mg/l from S2 brand and 1.1mg/l from S3. The values of nitrates in S4 were 1.4mg/l, S9 12mg/l, and S7 brand 14mg/l.
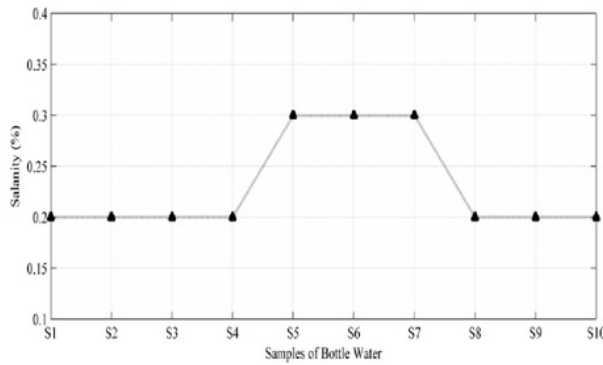
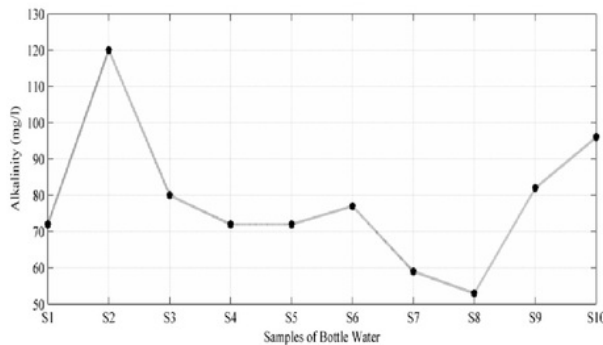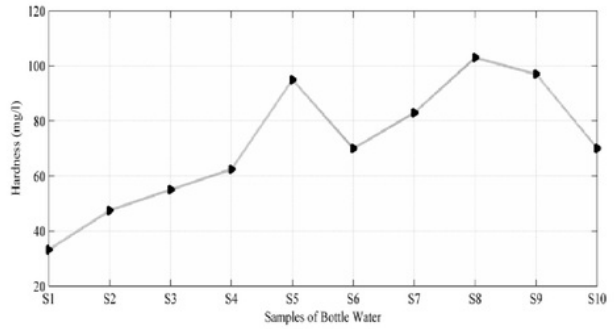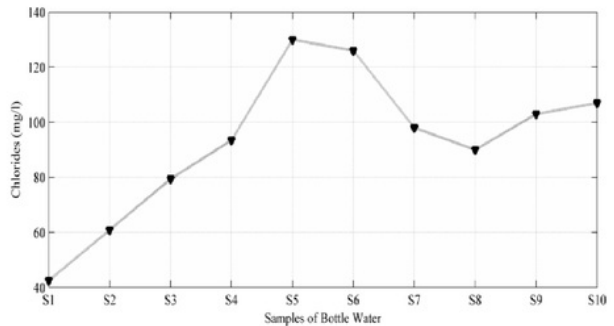Fig-6   Level of hardness in bottled water samples

Fig-7   Level of chlorides in bottled water samples

Fig-4   Level of salinity in bottled water samples

Fig-8   Level of fluoride of in bottled water samples
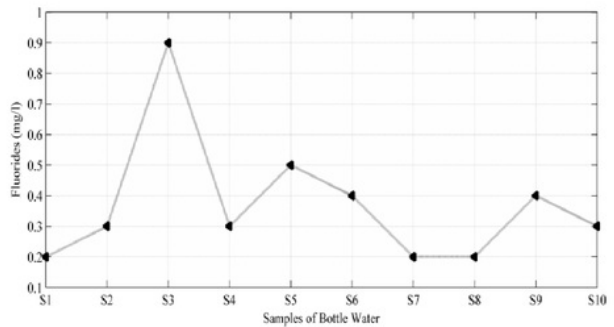
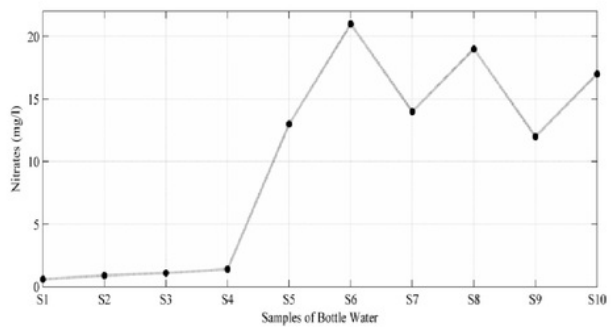Fig-5   Level of alkalinity in bottled water samples

Fig-9   Level of nitrates in bottled water samples

IV.   CONCLUSION

In this study, a total of 10 local brand water samples were assessed for the physicochemical properties. It is revealed from the study that the pH value of S9 and S8 bottled water samples were slightly less than World Health Organization guideline values. The lower pH can cause calcium deficiency in human which are dependent acidic waters. The results of S1, S2, S4, S5, S7 and S10 water brands were found within guideline values. It is strongly recommended that Environmental Protection Agencies should organize seminars, workshops and training programs to create awareness among masses about the adverse impacts of polluted water.

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