Quality study of the piped water of state company for drugs industry of Samarra and matching with the Iraqi and international drinking specification

Rafah Talal Ahmed Alsamaraay\textsuperscript{1*}, Riadh Abbas Abdul Jabbar\textsuperscript{1} and Tawos Mohammed Alshawany\textsuperscript{1}

\textsuperscript{1}Department of Biology, Collage of Sciences, Tikrit University, Iraq.

*E-mail: mtawis@yahoo.com

Abstract. The research aimed to evaluate piped water that supply the general company for pharmaceutical industry of Samarra and its suitable for drinking through the comparison with Iraqi and international standard for drinking. The study started from May (2015) until January (2016). Moreover, know the physical, chemical and bacterial properties piped water. The results showed that the piped water was matching of the drinking water by WHO and Iraqi standard. Only calcium quantity was higher than determination. The values rate for: Air and water temperature (29.44, 21.3\,^\circ\text{C}) respectively, EC (431.11) \, \mu\text{S/cm}, TDS (430) \, \text{mg/L}, the pH (7.7), DO (4.75) \, \text{mg/L}, while the BOD5 (1.25) \, \text{mg/L}, while Alkalinity hardness (157.77) \, \text{mg/L}, total hardness (155.55) \, \text{mg/L}, calcium and magnesium hardness (78.66, 72) \, \text{mg/L} Respectively. While chloride (68.22) \, \text{mg/L}, as for the phytonutrient, Nitrate concentration were (1.902) \, \text{Mg/L}, the phosphate concentration values rate (0.050) \, \text{Mg/L}, and silica concentration (1.981) \, \text{Mg/L}. The heavy metals, Cu (0.028) ppm, Iron (0.121) ppm, Zinc (0.203) ppm, Lead (Nil) ppm. And it was free from bacterial growth. Thus, quality of piped water, (completely purity).

Keywords. Piped water, Drugs industry, Samarra, Iraq.

1. Introduction

Water is the most vulnerable environments to pollution because of their distinguished quality, the negative effects of water pollution, are not only on humans, but also on trees and forest surrounding the world. Air and soil pollution is also the destination to watercraft, whether directly or indirectly [1]. In each country its importance, because it is the first coalition of a comprehensive reunion, aspiring to that country, according to professional and integrated development plans. In our Arab world the theme of water is very series, for more than reason, Arab world is the most arid areas and desertified in the world. In the other hand some Arab world are characterized by rain, and snow and many watercraft. Using water properly is a major problem in Arab world [2]. Water has also the potential to purify itself from its implications, with the help of the environmental purposes of self-purification, these pollutants are in the capacity of the source of affected to be affiliated with and processing [3]. Using contaminated water, caused many problems and disease moved to human such as cholera, typhoid and...
dysentery as well as different chemicals accumulated in the soil [4]. Tigris river basement, which is electrical conductivity, and it's freshwater with a low salinity. The concentration of plant nutrients are less than organism needs [5]. Moreover, the research aims to study the environmental and biological factors of the piped water that provide the state company for drugs industry of Samarra.

2. Materials and Methods

Samples of the piped water were collected for 9 months, starting from May (2015) until January (2016). The samples collected monthly during that period. Three repetitions taken for each sample of piped water, to determine the properties of each sample according to standard methods are globally durable [6]. Air and water temperature measurement was measured using Mechanical mercury (0-120) C°. Measurement of Electrical conductivity by using Digital conductivity model WTW German origin, results expressed by µs /cm. Use the pH meter model JENWAY England origin to measurement pH, after calibration with Buffer solution [3, 5, 7]. At the beginning of measurement process. Using Winkler Azid modification method to determine the concentration of Dissolved oxygen in water according to described method [8] results expressed by mg/L. as the same method to measurement BOD₃ using dark bottles. Measurement Total Dissolved Salts by using Digital conductivity model WTW German origin, after filtration the sample, results expressed by mg/L. Measured total hardness, calcium, magnesium and chloride according to described method (9). As well as Measured total alkalinity according to described method [10]. As followed method (11) to determine the nitrate, the active phosphate according to published method [12]. Depending on the American Society, for determine the concentration of active silica by using Spectrophotometer. In addition, heavy metals were determine by using Atomic absorption spectrum (AAS) [13]. The bacteriological testes by Total Plate Count as described in [14].

3. Results and Discussion

The physical properties of piped water as showed in Table (1) that air temperatures were variation and ranged between (10-40) C°, while water temperatures values between (7-31) C°, the high and low temperature surface water is affected by the air temperature [15]. EC values between (350-500) µs /cm, and it has related to the quality and concentration of the solvent ions in the water and increase with increased salinity [16]. TDS values between (350-500) mg/L, this increase maybe due to water containment on organic molecules or useful metals when it has found in the water such as nutrients or maybe cause water pollution by containing harmful material [17]. The physical properties of piped water matched with standard specification of Iraqi and international drinking water [18, 19, 20, 21].

| Table 1. Monthly changed for physical test of piped water during the study period. |
|-------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Months                        | May             | June            | July            | August          | September       | October         | November        | December        | January         |
|-------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Air temperature C°            | 35              | 36              | 37              | 40              | 38              | 34              | 23              | 12              | 10             | 29.44           |
| Water temperature C°          | 25              | 22              | 25              | 31              | 23              | 26              | 20              | 7               | 13             | 21.33           |
| Electrical conductivity µs /cm| 370             | 450             | 500             | 440             | 460             | 350             | 450             | 360             | 500            | 431.11          |
| Total dissolved salts mg/L    | 370             | 450             | 500             | 440             | 460             | 350             | 450             | 360             | 500            | 431.11          |
The chemical properties showed in Table (2), the pH values ranges between (7.3-8.2), and when compared pH values rate with the Iraqi and International properties in Table (4) which determinate that pH for natural water between (6.5-8.5), so it found within allowed range therefore not cause any problem in natural water [22]. DO values ranges between (4-5.9) mg/L, which suits a reflective with BOD5 that values ranges between (1-1.5) mg/L. As evaluate BOD5 values are typically with the pollution and temperature and inversely with DO concentration [23], that consistent by the Iraqi and International properties for drinking water Table (4). Thus, the water is excellent according to water resources that classified according to BOD5 values to excellent (1-75) mg/L, good (1.5-2.5) mg/L and poor (<2.5) mg/L [24]. The results of total alkalinity values showed between (120-250) mg/L, so it's within the Iraqi and international standard specification for drinking water. The higher of total alkalinity than the total hardness maybe belong to the high concentration of carbon dioxide from the air to water or moderation temperature, helping to soluble CO₂ in the water therefore increase of total alkalinity [25]. The total hardness values between (100-230) mg/L, so it's within the Iraqi and international standard specification for drinking water. The total hardness is close linked with magnesium and calcium salts, and these ions caused the hardness [26]. the results showed of high calcium values comparison with magnesium values, its maybe due to interact CO₂ with calcium more than its interact with magnesium [27], as the calcium values between (60-115)mg/L, which wasn’t within the standard specification for drinking water. While magnesium values between (46-100) mg/L, the reason for low concentration of soluble magnesium than the calcium due to tends the magnesium to precipitation in large quantities [28]. Chloride values between (62-125) mg/L, notes the high quality of chloride in the winter compared to the summer, as well as the chloride levels are a factor for water quality, in the fresh water the flow of chloride is low levels and increasing in concentration in winter clearly, because the drift and ruining that washing the soil [29]. it's found within the Iraqi and international standard specification for drinking water, Table (4).
Table 4. Iraqi and International chemical standard specification for drinking water (18, 19, 20, 21).

| References | Central device of the standardization and Quality Control (1996) | US-EPA (2002) | CEOH (2003) | WHO (2004) |
|------------|---------------------------------------------------------------|---------------|-------------|------------|
| pH         | 8.5-6.5                                                        | 8.5-6.5       | 8.5-6.5     | 8.5-6.5    |
| DO mg/l    | —                                                             | —             | 6.5-4       | —          |
| BOD₃ Mg/l  | 1                                                             | —             | —           | —          |
| Total Alkalinity mg/l | 170                      | 250           | 250         | 200        |
| Total Hardness mg/l | 500                  | 250           | 250         | 500        |
| Calcium Hardness mg/l | 50                      | 50            | 25          | 75         |
| Magnesium Hardness mg/l | 50                     | 125           | 50          | 125        |
| Chloride Ion mg/l     | 250                                                            | 500           | 250         | 250        |

As for the phytonutrient results that showed in Table (5), the nitrate values shown between (1.102-2.702) Mg/L, it was noted increase nitrate concentration in winter, that’s belong to the running and high watercraft that would be increase nitrate concentration by strong currents which causes mixing the sediments in water [30]. It’s found within the Iraqi and international standard specification for drinking water. Table (6). The active phosphate values between (0.013-0.140) Mg/L, so it’s found within the Iraqi and international standard specification for drinking water, Table (6). Silica values between (0.15-3.28)Mg/L, notes an increase silica comparison with the other studied phytonutrients, perhaps this increase to be more than (60%) from the earth's crust rocks and its soil contains silica, so its expected found as suitable mounts in natural water between (1-10) mg/L [7].

Table 5. Monthly changed for phytonutrients test of piped water during the study period.

| Variables                     | May    | June   | July   | August  | September | October  | November | December | January | Rate    |
|-------------------------------|--------|--------|--------|---------|-----------|----------|----------|----------|---------|---------|
| Nitrate Mg/l                  | 1.102  | 1.981  | 2.486  | 2.101   | 1.310     | 1.479    | 2.702    | 1.590    | 2.465   | 1.902   |
| Active phosphate Mg/l         | 0.140  | 0.027  | 0.013  | 0.015   | 0.026     | 0.021    | 0.016    | 0.120    | 0.076   | 0.050   |
| Active Silica Mg/l            | 3.28   | 1.24   | 1.21   | 3.15    | 2.20      | 2.33     | 0.15     | 1.26     | 3.01    | 1.981   |

Table 6. Iraqi and International phytonutrients standard specification for drinking water (18, 19, 20, 21).

| References | Central device of the standardization and Quality Control (1996) | US-EPA (2002) | CEOH (2003) | WHO (2004) |
|------------|---------------------------------------------------------------|---------------|-------------|------------|
| Active Phosphate Mg/l         | 0.4                                                           | 0.5           | —           | 0.4        |
| Nitrate Mg/l                   | 50                                                            | 45            | 10          | —          |

The results showed low of heavy metals values in piped water as shown in Table (7); the reason may be tend the heavy metals to adsorb on the surfers of sedimentation or forming complexes with the organic matters [31]. Cupper values between (Nil-0.099) Mg/L. Iron values between (Nil- 0.214)
Mg/L, so the heavy metals found less in pH more than 4 \cite{32}. Zinc values between (Nil-0.811) Mg/L. Lead is most effective elements in the health, it has also proved several studies from which study \cite{33}.

The results showed free piped water during the study, As well as the heavy metals studied were low from the Iraqi and international standard specification for drinking water \cite{18, 19, 20, 21} (Table 8).

**Table 7.** Monthly changed for heavy metals test of piped water during the study period.

| Elements | May  | June  | July  | August | September | October | November | December | January | Rate  |
|----------|------|-------|-------|--------|-----------|--------|----------|----------|---------|-------|
| Cu Mg/l  | 0.070| 0.045 | Nil   | 0.053  | Nil       | 0.099  | Nil      | 0.084    | 0.028   |
| Fe Mg/l  | Nil  | 0.211 | 0.181 | 0.172  | Nil       | 0.101  | 0.214    | 0.212    | 0.121   |
| Zn Mg/l  | 0.034| 0.712 | 0.023 | 0.811  | Nil       | 0.053  | 0.115    | 0.081    | 0.203   |
| Pb Mg/l  | Nil  | Nil   | Nil   | Nil    | Nil       | 2.552  | 2.585    | 2.852    | 2.858   |

**Table 8.** Iraqi and International heavy metals standard specification for drinking water \cite{18, 19, 20, 21}.

| Elements | Central device of the standardization and Quality Control (1996) Mg/l | US-EPA (2002) Mg/l | CEOH (2003) Mg/l | WHO (2004) Mg/l |
|----------|-----------------------------------------------------------------|-------------------|------------------|-----------------|
| Lead Mg/l | 50 | 50 | 10 | 10 |
| Copper Mg/l | 1000 | 1000 | 2000 |
| Zinc Mg/l | 1000 | 5000 | 3000 |
| Iron Mg/l | 500 | — | 3000 |

The bacterial testing for water is the important testing, because its indicator for founding or absent the harmful microorganisms for health \cite{34}. Therefore, the total bacterial count that studied, and didn’t record any bacterial growth during the study. So TPC found within the Iraqi and international standard specification for drinking water, which is mount (50) cfu /ml, therefore the piped water is (completely pure), depending on the bacterial properties \cite{35}.

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