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An assessment of the quality of drinking water in Benghazi City, Libya(Determination of physical parameters)

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ABSTRACT

The major sources of water supply of Benghazi city is the River Project which is represented in Talhia reservoir where water flows through pipes in the network of water distribution from Talhia reservoir to different positions in the city. In this study we divided the study area (The network of water distribution) into three areas A, B and C according to the distance away from Talhia reservoir. Drinking water samples were collected from twenty six positions of Benghazi city during spring and summer seasons-2009. These samples were subjected to systematic analysis using standard methods and procedures. The obtained results for water of the network were compared with Libyan and WHO drinking water standards. Physical parameters of the three areas A, B and C were compared for water of the network between spring and summer seasons. The physical parameters that were determined in this study are pH, temperature, electric conductivity (EC), total dissolved solids (TDS) and turbidity. All physical parameters of the network water samples agree well with Libyan and World Health Organization (WHO) drinking water standards, however we found that there are differences in the majority of physical parameters of water between the studied three areas A, B and C, there are differences between results of spring and summer seasons. There are small values of turbidity in some positions at summer season these values were less than that of Libyan guide line values (5NTU).

Keywords : Drinking water, pH, temperature, EC, TDS and turbidity

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INTRODUCTION

Water is the elixir for life. Adequate supply of potable safe water is absolutely essential and is the basic need for all human being on the earth.[1] The three percent of global fresh water is large enough to meet the requirements of man for million of years etc. [2] Water is not only a vital environmental factor to all form of life, but also it has a great role to play in socio-economic development of human population.[3] The pH is one of the most important measurements commonly carried out in natural waters and wastewaters. pH indicates the balance between the acids and bases in water and is a measure of the hydrogen ion concentration in solution. The content of H^+ ions in natural waters is mainly related to the quantitative ratio of carbonic acid and its ions. [1] A number of minerals and organic matter interact with one another to give the resultant pH value of the sample.[3] A pH greater than 8.5 interferes with the disinfection process of drinking water. While a pH below 6.5 can result in corrosion in the distribution system and affect the availability of nutrients and the relative toxicity of many trace elements. [1] The optimum pH required often being in the range 6.5–9.5. [4] Water bodies undergo temperature variations along with normal climatic fluctuations. These variations occur seasonally and, in some water bodies, over periods of 24 hours. The temperature affects physical, chemical and biological processes in water bodies and, therefore, the concentration of many substances are variables. Surface waters are usually within the temperature range 0°C to 30°C, although" hot springs" may reach 40°C or more. Abnormally high temperatures in water can arise from thermal discharges,

usually from power plants, metal foundries and sewage treatment plants. [5] Electrical conductivity (EC) is the measure of the ability of the water to conduct an electrical current. Conductivity in water is affected by the presence of inorganic dissolved solids. It is affected by temperature. [1] The high values of EC are found to correlate with total dissolved solids, [6] which it is an index of the amount of dissolved substances in water. However, the presence of high levels of TDS in drinking-water (greater than 1200mg/L) may be objectionable to consumers. Water with extremely low concentrations of TDS may also be unacceptable because of insipid taste, [4] TDS value should be less than 500 mg/l. [7] Turbidity is the cloudiness of a fluid caused by suspended matter, such as organic and inorganic matter, and plankton and other microscopic organisms [5-8] According to the Environmental Protection Agency (EPA), in drinking water, the higher the turbidity level, the higher the risk that people may develop diseases. The suspended solids interfere with water disinfection with chlorine because the particles act as shields for the virus and bacteria. Similarly, suspended solids can protect bacteria from ultraviolet (UV) sterilization of water. [9-10]

MATERIALS AND METHODS

All chemicals and reagents used for calibration and analysis were of analytical grade. Double distilled water was used for the preparation of all the reagents and solutions. Measurement of pH and temperature of water samples were done in the field by using pH/Temperature meter [model Corning – 313 pH/Temperature], after calibration the instrument by standard buffer solutions of pH 4, 7 and 9. EC and TDS of samples were measured by using the conductivity meter [model JENWAY – 470], after calibration the instrument by standard potassium chloride solution, KCl- 0.01N the reading was 1413 µS /cm at 24.8°C, Turbidity was measured by using the turbidimeter [model NEPHLA DR LANGE] by make of standard calibration curve which shows in figure (1) through preparation standards solutions 1, 3, 5 and 7 NTU by dilution stock formazine turbidity suspension solution 4000 NTU.

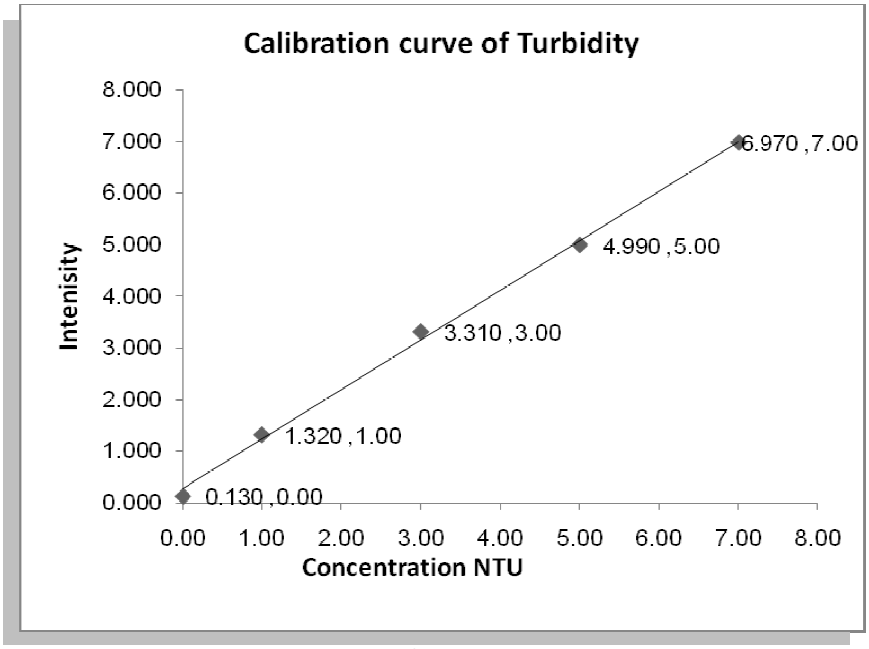

Figure (1): The calibration curve of the samples turbidity by Nephlometer.

RESULTS AND DISCUSSION

The range values of pH, Temperature, EC, TDS and Turbidity of A, B and C areas (The network system) in the spring season were illustrated in table (1).

ANOVA and Multiple Comparisons tables of pH, temperature, EC, TDS and turbidity in spring season indicated that there are small significant differences (P-value < 0.05) in the mean values of pH, temperature, EC, TDS within and between the three areas (A, B and C), such the mean values of pH of the above areas were in the range B> A> C, the mean values of temperature were in the range C> A> B, the mean values of EC and TDS of the previous areas were in the range C> B>A, while the mean values of turbidity of all positions of the three areas in this season was zero. In summer season there are small significant differences (P-value < 0.05) in the mean values of pH, EC

and TDS within and between groups of A, B and C areas, but there are not significant differences (P-value > 0.05) in the mean values of temperature and turbidity, the mean values of pH were in the range A> B> C, the mean values of EC and TDS were in the rang C> B>A. The following figures summarize the experimental comparison of the mean values of the physical parameters of three different areas, figure (2) of mean values of pH, figure (3) of mean values of Temperature, figure (4) of mean values of EC, figure (5) of mean values of TDS and figure (6) of mean values of Turbidity.

Table (1): The average physical parameters of areas A, B and C (The network system) in the spring season

Area / Parameter	A	B	C	Min. value	Max. value	Average	SD	SE
pH	8.14	8.24	8.05	8.05	8.24	8.14	0.1195	0.0234
Temperature (°C)	27.4	23.4	27.6	23.4	27.6	25.9	3.6730	0.7203
EC (µS/cm)	953.88	964.50	1016.38	953.88	1016.38	976.92	51.6820	10.136
TDS (mg/L)	571.63	578.80	609.63	571.63	609.63	587.62	30.5248	5.9864
Turbidity (NTU)	0.00	0.00	0.00	0.00	0.00	0.00	0.0000	0.0000

The range values of pH, Temperature, EC, TDS and Turbidity of A, B and C areas (The network system) in the summer season were illustrated in table (2).

Table (2): The average physical parameters of areas A, B and C (The network system) in the summer season.

Area / Parameter	A	B	C	Min. value	Max. value	Average	SD	SE
pH	8.14	8.13	8.03	8.03	8.14	8.10	0.1058	0.0208
Temperature (°C)	31.1	30.3	31.4	30.3	31.4	30.9	2.8591	0.5607
EC (µS/cm)	855.13	908.60	1016.88	855.13	1016.88	925.46	134.4662	26.371
TDS (mg/L)	513.50	545.20	609.88	513.50	609.88	555.35	80.6444	15.8157
Turbidity (NTU)	0.00	0.05	0.18	0.00	0.18	0.08	0.0951	0.0439

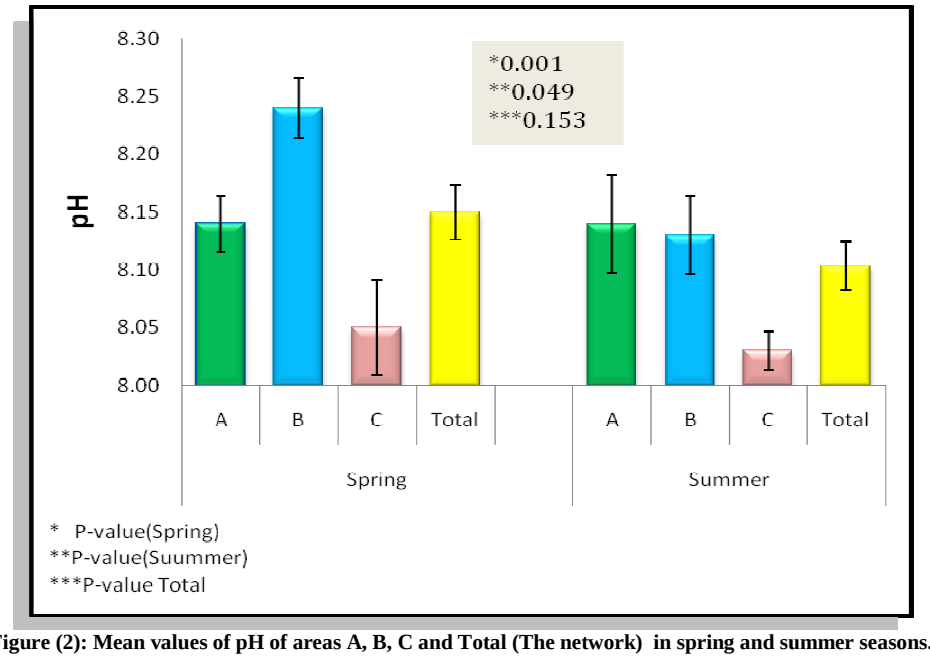

Figure (2): Mean values of pH of areas A, B, C and Total (The network) in spring and summer seasons.

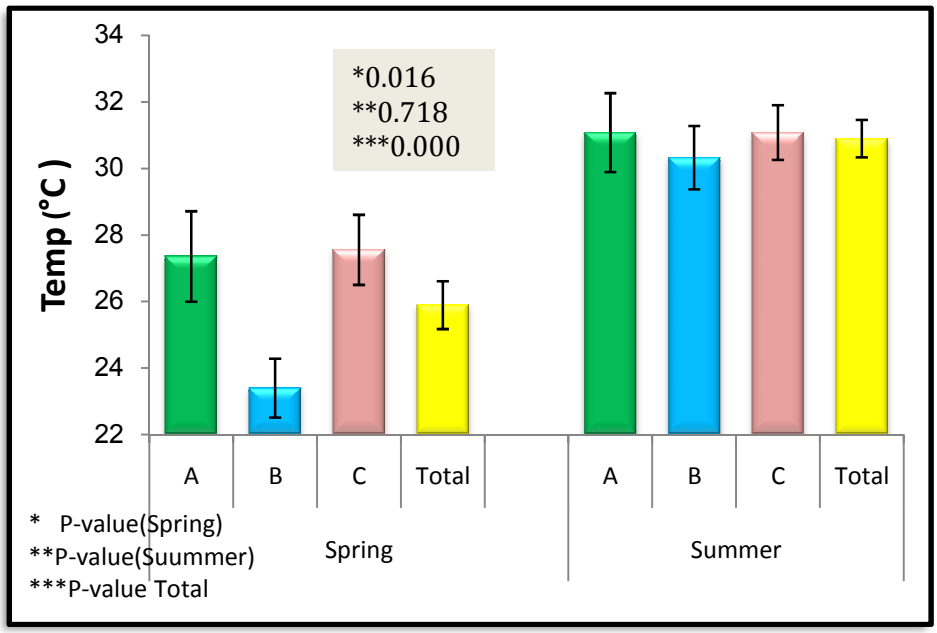

Figure (3): Mean values of Temp. of areas A, B, C and Total (The network) in spring and summer seasons.

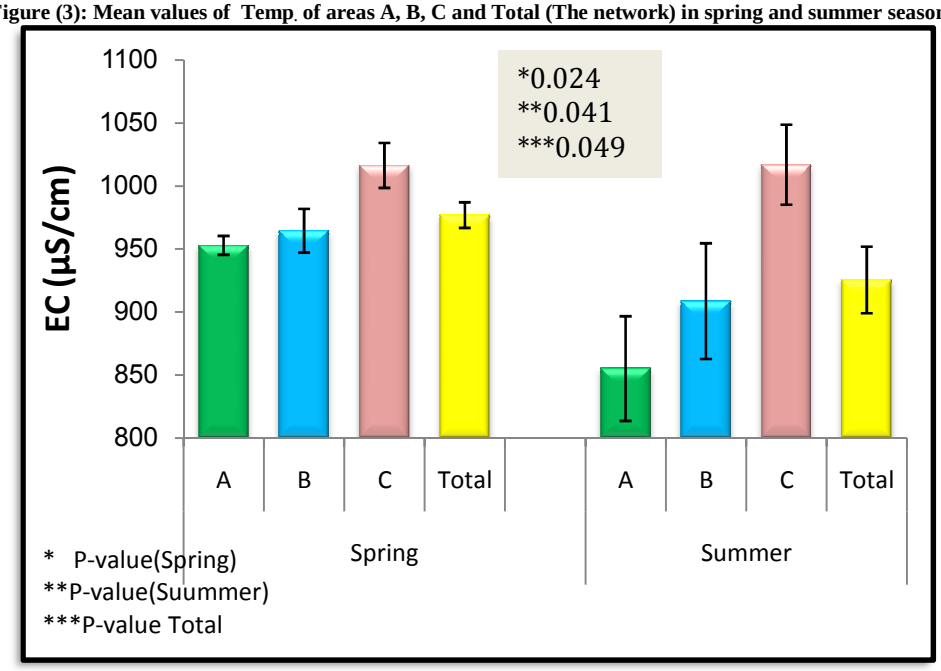

Figure (4): Mean values of EC of areas A, B, C and Total (The network) in spring and summer seasons.

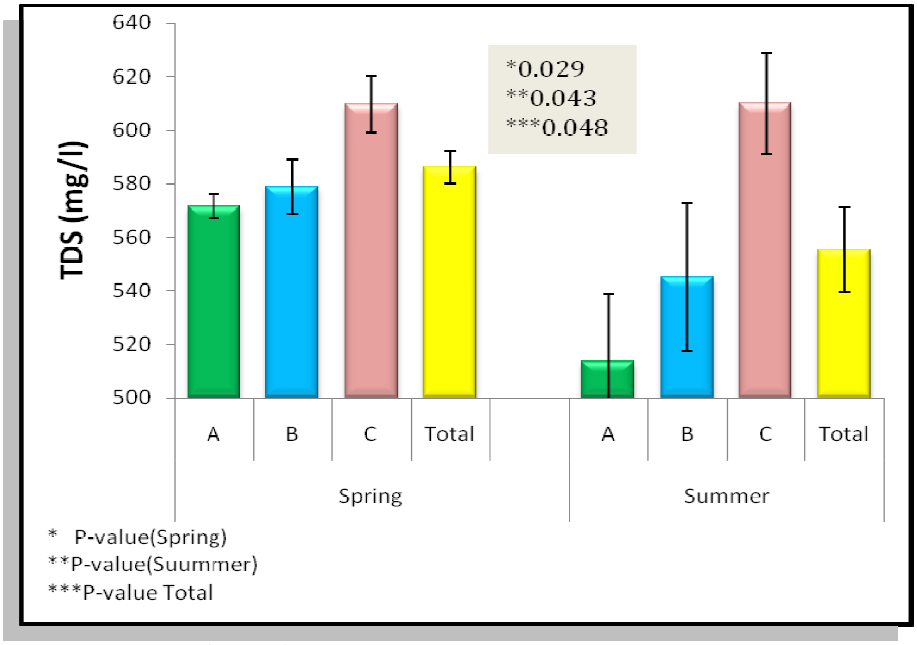

Figure (5): Mean values of TDS of areas A, B, C and Total (The network) in spring and summer seasons.

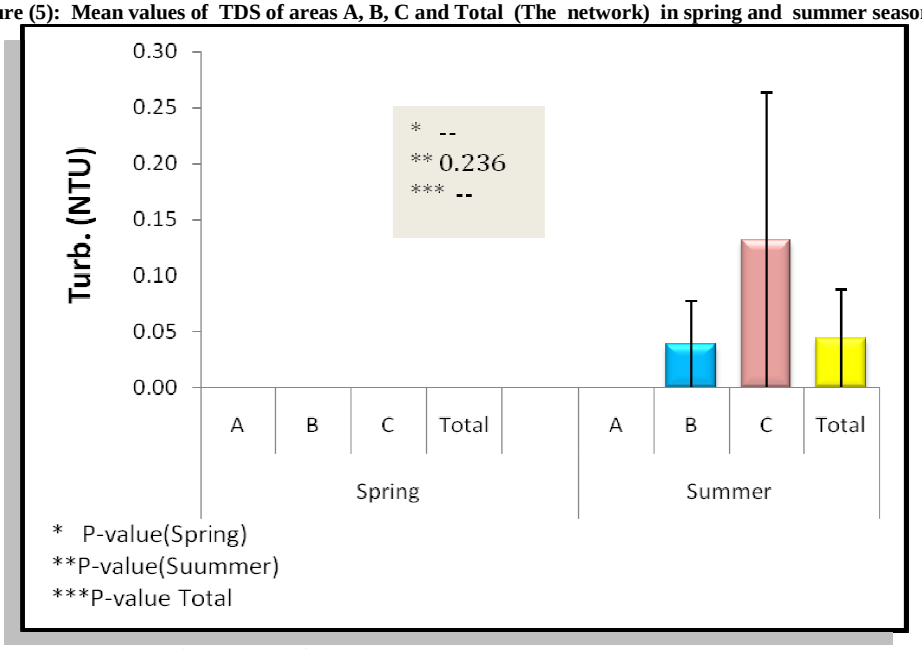

Figure (6): Mean values of Turbidity of areas A, B, C and Total (The network) in spring and summer seasons.

CONCLUSION

All the physical parameters of the drinking water samples agree well with Libyan and WHO drinking water standards (Less than Libyan and WHO guideline values), so drinking water of the network of water distribution of Benghazi city has high quality compared with the results obtained by A. A. El Hossadi & co workers for drinking water of Benghazi city in the period 1982 – 1984 where in that period Benghazi city was provided with multichannel water supply sources ranging from desalination plants to deep water wells. [11] The differences in our parameters are may be due to the nature of pipes of the network in the different sampling positions, leashing of salts from pipes or due to large distance between the major source (Talhia reservoir) and the end of the network which lead to drop in water flow and increase the chance of water contact with salts inside the pipes. In comparison between results of spring season and results of summer season we found differences in the majority of physical parameters but these differences don't resulted from variation of seasons where our study carried out water inside pipes of network distribution system but temperature of air surround the pipes affect temperature of water inside these pipes of the network therefore the temperature of water increased in summer season, but EC, TDS in spring were higher than in summer, although these differences were small, that may be due to nature of the reservoirs, pipes or the source of water supply which may be the consumption of water in spring season from Sarir well field

was more than that from Tazerbo well field, where water of Sarir well field have a high values of EC, TDS. Although there are small differences in these parameters but they didn't affect the quality of the mentioned studied areas.

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