



Research Article

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Statistical Test for Water Quality Parameters of Euphrates River at Najaf Province during Winter and Summer Seasons

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ABSTRACT

This research aims to study the seasonal variation in water quality parameters of Euphrates River at Najaf Province in Iraq during winter and summer seasons by using statistical test. Six water quality parameters were measured during the period from 2007 to 2012 in January and July. These parameters were hydrogen power (pH), electrical conductivity (EC), total dissolved solids (TDS), magnesium (Mg^{+2}), chlorides (Cl), and sulfates (SO_4^{-2}). Paired t-test was used six times to estimate the equality and inequality of the six water quality parameters in January and July. It was noticed that the values of water quality parameters in July were greater than their values in January for more parameters at significant (0.01) except for EC, where the test accept the equality hypotheses. This means that the water quality of the Euphrates River in Najaf Province became worse in summer than in winter for most parameters.

Key words: Euphrates, water quality parameter, Najaf, Iraq, paired t-test

INTRODUCTION

Euphrates River passes through Najaf Province in Iraq. It is one of the hottest places. Its weather is hot and dry in summer, and cold and dry in winter. January is the coldest month in Najaf, while July is the hottest (Fig. 1). The aim of this paper is studying the effect of seasonal changes on water quality parameters of Euphrates River at Najaf Province by using statistical test.

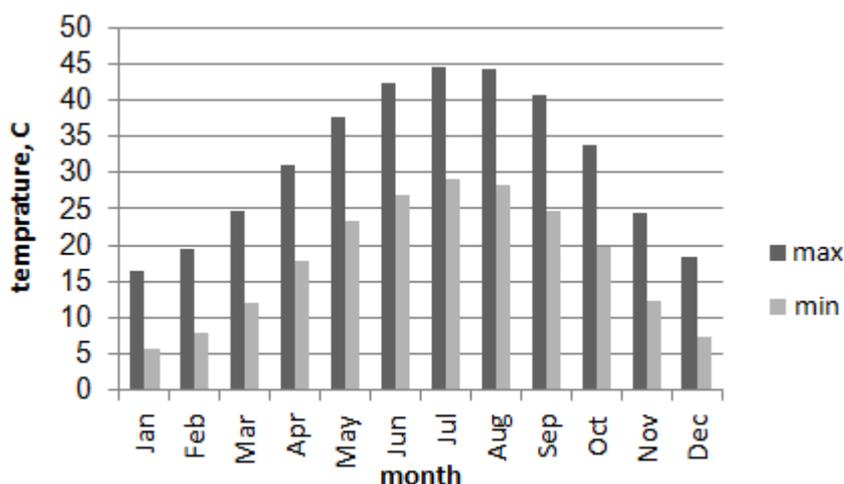


Fig. 1: Annual means of temperatures for Najaf Province from (1981 – 2011) [1]

CASE STUDY AND STUDY PERIOD

Six water quality parameters were measured along Euphrates River in three sites at Najaf Province. These sites were in Kufa, Mishkhab, and Abbasia as shown in Fig. (2). These water quality parameters were hydrogen power (pH), electrical conductivity (EC), total dissolved solids (TDS), magnesium (Mg^{+2}), chlorides (Cl^-), and sulfates (SO_4^{-2}). They were measured on January and July months for the six years (2007 – 2012).

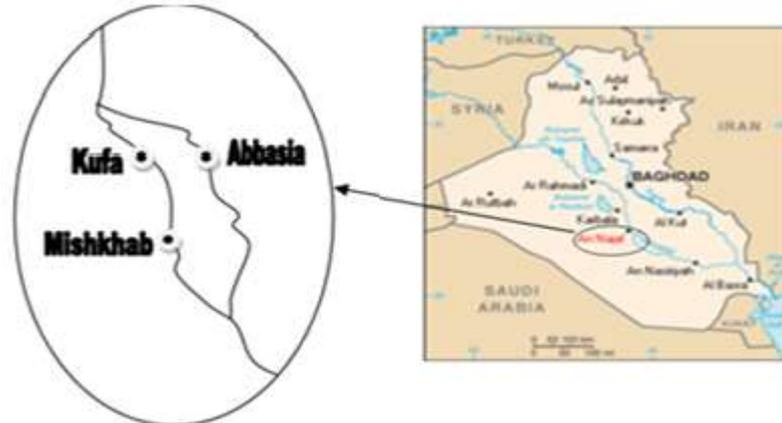


Fig. 2 The case study of euphrates river in Najaf Province

Figs (3-5) represents the values and concentrations of the six water quality parameters of Euphrates River in the three sites of Najaf Province during January and July of the study period from (2007 – 2012) with their maximum and optimum standard for drinking use. It is noticed that the values of water quality parameters in July are greater than January in most cases. It is important to know if this increasing of values in July is significant or not. So paired *t*-test will be used to estimate the seasonal effect on these values of water quality parameters.

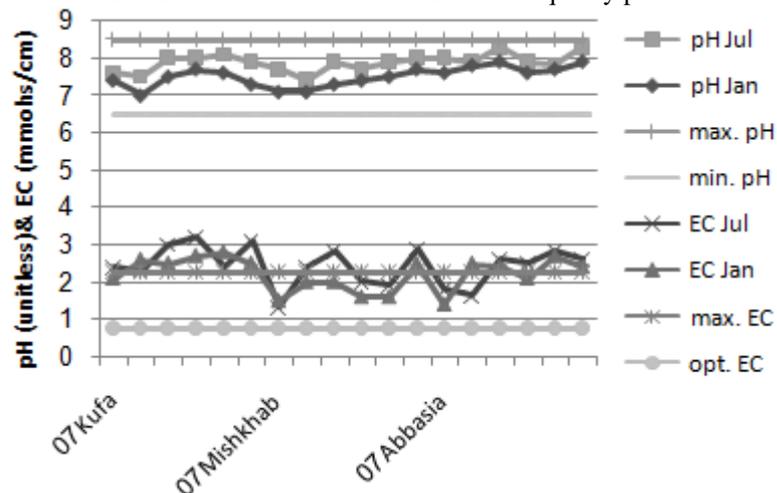


Fig. 3 Values of pH and EC during the study period with optimum and maximum limits for drinking use [2 & 3]

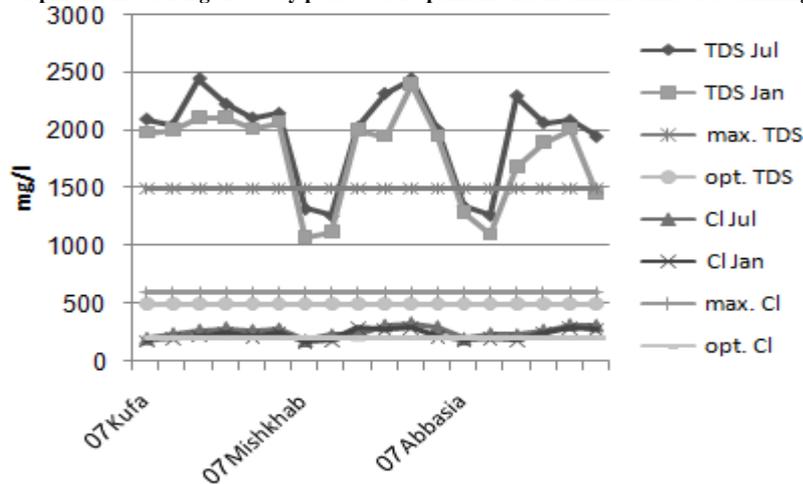


Fig. 4 Concentrations of TDS and Cl^- during the study period with optimum and maximum limits for drinking use [2 & 3]

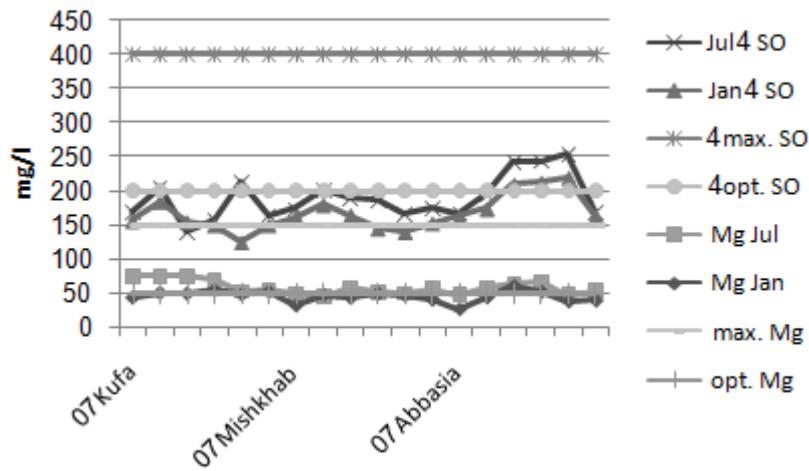


Fig. 5 Concentrations of SO_4^{2-} and Mg^{+2} during the study period with optimum and maximum limits for drinking use [2 & 3]

PAIRED *t*-TEST

This test supposes that the observations are ordered as pairs (X_i, Y_i) having the same length (n), which cannot be treated as independent variables. The four steps below illustrate this test Abu Salih and Awad, [4], and Hogg and Craig [5]:

- a) Determining the null hypothesis ($H_0: \mu_x = \mu_y$) corresponding to the alternative hypotheses ($H_1: \mu_x \neq \mu_y$), ($H_1: \mu_x > \mu_y$) or ($H_1: \mu_x < \mu_y$), where μ_x and μ_y are the arithmetic means of observations x_i and y_i subsequently.
- b) Finding the test function:

$$T = \frac{\bar{D}}{S_D/\sqrt{n}} \tag{1}$$

where \bar{D} represents the arithmetic mean of difference $D_i = x_i - y_i$, S_D represents the standard deviation of the difference D_i , and n represents the length of the paired.

$$S_D = \sqrt{\frac{\sum_{i=1}^n (D_i - \bar{D})^2}{n-1}} \tag{2}$$

- c) Determining the tabulated value from t-distribution table at ($n-1$) degree of freedom, where the test function (T) submits to this distribution.
- d) Adopting the statistical decision either accepts the null hypothesis (H_0) or rejects it. The decision will accept the null hypothesis if the test functions is located in region of acceptance and will reject the null hypothesis if the test function is not located in region of acceptance as shown in Fig. 6.

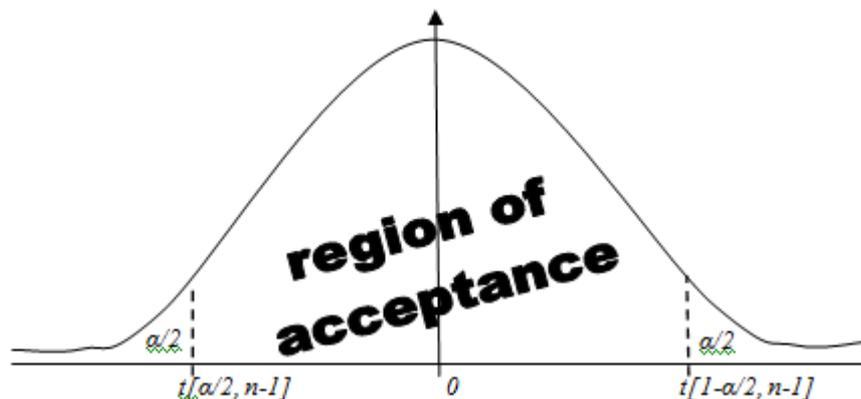


Fig. 6 Region of acceptance in paired *t*-test

RESULTS AND ANALYSIS

Table (1) illustrated the details of paired *t*-test for the six water quality parameters of Euphrates River in Najaf Province at significant 0.01. The statistical decisions for the test were rejecting the null hypothesis (H_0) for all water quality parameters except the EC, which the statistical decision was accepting the null hypothesis. The reason for

rejection the null hypothesis was that the absolute values of the test function $|T|$ for these parameters were greater than the tabulated value $t [0.995; 17]$. This means, there is seasonal effect for these water quality parameters and the increasing of their values in July month (summer season) was significant during the study period.

CONCLUSION

It could be concluded that the water quality parameters for Euphrates River in Najaf Province during the period from (2007 – 2012) were greater in summer season than in winter season according to paired t -test. This increasing in their values made them not suitable for drinking use according to optimum standard. The deterioration of TDS and EC was clear where their values were greater than the maximum standard for more years especially in July months.

Table - 1 Steps of Paired t -test

Parameter	D	S_D	$ T $	$t[0.995;17]$	Statistical decision
pH	-0.38	0.16	10.3	2.90	Reject
EC	-0.21	0.41	2.11	2.90	Accept
TDS	-183	167	4.64	2.90	Reject
Mg^{+2}	-14	9.38	6.31	2.90	Reject
Cl^-	-35.1	26.2	5.68	2.90	Reject
SO_4^{-2}	-22.8	20.9	4.62	2.90	reject

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