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Evaluation of the Physical and Chemical Properties of a Number of Aquarium Waters in Kirkuk Governorate and Determination of Bacterial Content of Pond Water

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***Abstract:** This study aimed to evaluate the fish ponds in the outskirts of Kirkuk, starting from the Hawija district, Daqouq, Lylan, Yayji and Taza, and the tests were conducted in the Department of Environment and Agriculture and included water samples of carb fish ponds. The physical, chemical and biological traits were measured for January 2024. The temperature recorded the highest value of 40 m in September in the first station. The highest value of electrical delivery was recorded in the September at the fifth station, as it amounted to 3.227 microscopes/cm and the lowest value of 0.477 microscopes/cm per month in the fourth station, and the results showed the high values of electrical conductivity at the fifth station in all study months. As for the values of the total soluble solid materials at the five study stations, the highest value of 1860 mg/l in November was recorded in the fourth station and the lowest value in the same station was recorded in August, the results showed the high values of the total solid materials in the fifth station in all months of the study. As for the values of Akkara, it ranged between 111-0.833 mg/l, and the highest value of 111 mg/l was recorded in the month of August in the fourth station and the lowest value of 0.833 mg/l in November in the first station, and it was noted through the table the high values The second in all months of the study, and the values of the pH in fish ponds ranged between 6.4-7.4, meaning that the water in the fish ponds tends to be a little alkaline, as the fifth station in the month of August was registered with the highest values of hydrogen, 7.4, and the value was recorded at the second station 6.4.*

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Keywords: BOD, Chemical and Physical Characterstics, Dissolved Oxygen, Temperature, BOD5, TDS, E.C, pH, T.P.C.

1. INTRODUCTION

Fish is one of the natural food sources that live in water and consumes a person, contains many nutrients such as protein, minerals, fats, oil, and etc . Fish basins are created where fish are fed and their growth is easily observed. Among the most important types of this fish are carp, tilapia, shelter, and cod. Pelvic water sources are useful for various purposes, including raising water bumper and other related uses at the local level, where there are pools (ponds) that are naturally formed by decline in the Earth's crust by keeping water Fish basins are an industrial lake (tank, pond) intended for fish raising, where fish are considered one of the most raised animals in fish basins[1] .Water shortage is one of the prominent challenges facing national security, especially in the areas that suffer from water scarcity[2]. According to recent reports, the crisis is expected to escalate in the future as a result of the scarcity of water and the urgent need to provide it, and this indicates that the problem has become a global phenomenon par excellence[3]. The use of water resources is witnessing a remarkable increase, especially in the semi-dry areas of Iraq. Therefore, great interest in assessing the quality of these water resources should be paid in order to maintain the health of society and preserve the environment[4] .As a result of the expansion of the industrial field and the increase in population in the city of Kirkuk, the demand for water witnessed a significant increase to meet all the needs and uses[5] that water biology as well as fish fisheries are directly related to several goals for sustainable development, and among the most prominent of these goals is the desire to preserve water resources and water resources and exploit them in a sustainable manner, according to the directives of the Food and Agriculture Organization [6]. Due to the increasing deficiency of water resources, it is considered to reuse and direct it towards other purposes as an ideal alternative. It is often viewed by the use of this redesed water in agricultural irrigation as an effective way to recycle water due to the huge quantities available from it, and through it the recycling of the elements and this contributes greatly to reducing dependence on water extraction from natural water resources[7]. Water -transferred infection is spread widely, as (2.5) billion people do not get improved sanitation and more than (1.5) million children die every year as a result of diarrhea[8]. Recently, investigators and environmentalists have become anxious about surface pollution [9] . Since the water is a natural habitat for fish, it is highly focused on its quality when managing fish ponds and assessing its impact on the environment. The term 'water quality' is linked to the elements in water that plays a decisive role in achieving the optimal growth of water organisms. The level of water quality is affected by physical, chemical and biological factors in the water, which also affects its use in fish farming purposes. For example, these factors indicate the level of pollution in a specific water surface [10]. As the increased levels of pollution in the aquatic environment usually lead to multiple changes in aquatic organisms as a result of environmental degradation, and this is especially evident when pollutants remain permanent Water organisms [11] . The Water Quality Index (WQI) explains that the overlapping effects of the studied standards used to determine water quality and (WQI) are one of the most widely used ways to control surface water pollution [12].

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2. RELATED WORKS

[13] Referred in their studies that optimal fish production depends largely on physical and chemical characteristics. in addition to the study of[12] untile the water contaminated pollution (dumping of raw sewage into rivers without proper management) represents global issuefacing several countries,this leads to a Deterioration of water quality and the infection risk.[14]Water should be healthy and unpopular, home drainage water contains many microorganisms such as viruses, bacteria and parasites carrying many diseases, unpleasant and polluted water negatively affects the balance of the vital surroundings of the Earth, causing harm to humans. [15] in their study to assess the quality of water produced from the Hawija district desalination plant - Kirkuk that the plant produces high quality water and is suitable for various human uses, including drinking, and they showed in other study. Monthly and spatial variations in these environmental factors in terms of temperature and pH were studied by[16], over several months of the year, allowing to understand their impact on the aquatic environment and fish health. The results of her study showed monthly and spatial differences in water temperature and pH levels between the studied areas. These results were compared to international standards for fish water quality, and found that most ponds meet these standards, suggesting that fish farming practices can be improved

3. METHODOLOGY

Study Area

Kirkuk Governorate is located in the northern part of Iraq between the two shows (28-35) with the length line (23-44) and is bordered by the Erbil Governorate from the north and Salah al-Din from the west, south and Sulaymaniyah in the east[17] .The chemical, physical, and biological properties have been studied monthly for a period of (6) months for the water of five fish farms in separate places from the outskirts of Kirkuk Governorate (Hawija district, Daqouq district, Yayji district, Taza district, Lilan district). All basins were made in the manner of earthen basins of different areas and supplied with water through closed deep artesian wells, and were drilled by mechanical excavators and the depth of the wells ranges between (100-150) meters and the period of use between (10-15) years. The selection of study areas for fish ponds came due to the lack of studies and scientific research in them, the presence of diseases and the occurrence of successive deaths of fish in breeding ponds.

Sampling Collection

The physical, chemical and biological characteristics are measured, which are the main axis of the water environment such as the saline, basal, hardship and concentration of negative and charged ions, where the water temperature was measured using the mercury\pH, while the Digital pH meter is used to measure the pH, while Use the device (E.C Temperature) to measure the electrical connection, the soluble hard materials were measured using the T.D.S Meter, while the vital requirement of oxygen was measured using a device (DO Meter) . The turbidity was measured using a device (Turbidity Meter), a device (DO Meter) was used to measure dissolved oxygen, the device (Flame Meter) was used to measure the concentration of potassium ion, while the device itself was used to measure the concentration of sodium

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ion, salinity was measured based on electrical conductivity values (E.C), total basicity was measured according to the method followed by[18] ,while total hardness, magnesium hardness and calcium hardness were measured using the method described in[19].

Fish Samples Collection

Fish samples were randomly collected in Kirkuk, where the process of collecting samples began from eight in the morning until twelve o'clock in the afternoon, starting from the first site (Hawija) and ending with the fifth site (night) for a period Father from the year (2023 until February 2024), samples were collected from the pelvic water in the surface layer depth (30) cm using polyethylene (2.25) liters of polyethylene Taking into consideration that the bottle nozzle is below the surface of the fish ponds of the lowest airflow.

Water Samples Collection

Water samples were collected for bacteriological study in glass containers with a tight cover and a narrow nozzle (200-250) ml and was sterilized in electrical insulation under a temperature (160-180) ṁ for an hour to an hour and a half. Water samples were collected from below the surface of the pond water at a depth of (10-20) cm, and the samples were transferred to the laboratory in iced Flanty containers at a temperature of (4-6) mi within (1-2) hours to perform bacteriological examinations. Swams were taken from different areas of the fish body (mouth, scales, galaxy, tail, fins), and transferred to the laboratory (1-2) hours.

4. RESULTS AND DISCUSSIONS

Temperature

The results of the current study indicated that there are monthly differences in the temperatures of the air surrounding the site of the study, as the highest value of 40 m in the month of September was recorded in the first station, followed by 35.7 m in the third station for the same month and the lowest value of 13.5 m in January in the third station, followed by 14 m in The fourth station for the same month in the third station, and the results showed the high temperatures in the first station in most months, and this water was classified as warm water according to the water classification due to its temperature[20], The results of the current study agreed with the results reached by[21] in Kirkuk, where the highest value was recorded in July if it reached 30 m and the lowest value in January and February, as it reached 10 m, and a study[22] also agreed in his study of the effect The density of the cultivation of carp fish in the dirt basins in Basra Governorate, as values ranged from 17-29 m, and a glorious study and its group in Erbil, as it was the highest value in July 35.7 m value in the month of January 9.4 m, studies indicate[23] to The presence of a direct relationship between the low temperatures of the surrounding air and the low temperature of the fish farm water, due to the loss of water temperature through the evaporation process, especially in light of the low air temperatures The results of the statistical test documented a positive correlation ($P \leq 0.01$) between temperature and study months ($r = 0.906$), pH ($r = 0.525$), BOD ($r = 0.578$) and the total number of TPC bacteria ($r = 0.625$) and a medium correlation with E.coli, ($r=0.376$) and ($r=0.405$) coliform respectively. Dunkin's test recorded no significant differences at $P \leq 0.05$.

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Table 1 Monthly and Location Temperature Changes

Location / Quarter	First Station	Second Station	Third Station	Fourth Station	Fifth Station
August	31.8	31.8	30.2	33.5	31.6
September	40	34.2	35.7	34	34.7
October	34.5	29.8	30.1	29.3	30.6
November	30.1	25.3	23.2	24.3	23
December	19.8	19.1	20.5	20	20.9
January	14.2	16.1	13.5	14	15.5

Electrical Connection (E.C)

The results of the study recorded different values of electrical delivery in the five stations under study, where the highest value of electrical delivery was recorded in the month of September at the fifth station, as it reached 3.227 microscopes / cm and the lowest value At the fifth station in all months of the study. The results of the current study showed an increase in the electrical connection values compared to the results of [24]. In his study on the morphological analysis of the Wadi al -Murr basin and the evaluation of the quality of its ongoing water, the electrical connection values ranged between 1.108 and 1.560 microscopes / cm, and with the results of [25] which recorded values for electrical connection ranging from 2.180 microscopes / cm, and the reason for the high values Electricity to the effect of salinity, overall hardship, hardship of calcium, magnesium, and total solid solids on electrical connection. 0.861) The total solid solids (R = 0.895), explaining the reason for the high values of electrical connection.

Table 2 Monthly and Location Changes of Electrical Connection

Location / Quarter	First Station	Second Station	Third Station	Fourth Station	Fifth Station
August	1.805	1.231	2.793	0.477	2.859
September	2.142	1.465	3.078	0.606	3.227
October	2	1.9	3.19	3.104	3.104
November	2.046	1.48	3.148	3.717	3.201
December	2.04	2	2.878	2.38	3.066
January	2.046	2.19	2.978	2.385	3.064

Total Soluble Solid Materials (TDS)

The results of the study documented the varying values of the values of the total soluble solid materials at the five study stations that the highest value of 1860 mg /l was recorded in November in the fourth station and the lowest value in the same station in the month of August, and the results in the table showed the high values of total solid materials dissolved at the station The fifth in all months of the study was the results of the current study less than the results of[21] in Kirkuk, which recorded the highest value for TDS 2140 mg / l in April in

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Daqouq, and less than the results recommended by[26]. Which ranged between 215 and 2210 mg/l, however, TDS values were at the fifth station in the Laylan area higher than those recorded by[27] in his environmental studies in the same aspect, as a record of values ranging between 417 and 1014 mg/l. Take document a moral connection relationship (P≤ 0.01) with electrical connection (R = 0.895), magnesium (R = 0.821) and total hardship (R = 0.845) and sodium ions (R = 0.651) because the TDS consists of basic suspicion of inorganic materials such as calcium and magnesium And bicarbonate, chc, sulfate, as confirmed by[28] , and my test analysis and Denkin analysis) confirmed at a moral level p≤ 0.05 (record moral differences between the values of the total soluble in the second site on the rest of the sites.

Table 3 Monthly and Localized Changes of Total TDS.

Location / Quarter	First Station	Second Station	Third Station	Fourth Station	Fifth Station
August	1030	740	1640	280	1700
September	1108	770	1568	310	1680
October	1050	1040	1065	1064	1063
November	1020	740	1570	1860	1600
December	980	1040	1370	1140	1460
January	982	1041	1372	1142	1461

Hydrogen pH

The results have been documented that the value of the pH in the fish ponds ranges between 6.4 - 7.4, meaning that the water in the fish ponds comes until it is a little alkaline, as the fifth station was recorded in the month of August the highest values of hydrogen 7.4 and the value was recorded in the second station. 6.4 The results of the current study agreed with[29], in their study on fish raising practices and the quality of the pond water, which ranged between 7-8 and less than the results of both[30] on the effect of the hydrogenic and the density of cultivation on the carp fish in the ponds , Where the Hydrogen AS values ranged 6 - 9.5, and a study[31] on the environmental and pathological commoners that afflict fish in Basra Governorate, where the Hydrogen AS values ranged between 6.9 - 8.4 based on the P≤ 0.05) test of the rest of the sites.

Table 4 Monthly and Localized Changes in pH.

Location / Quarter	First Station	Second Station	Third Station	Fourth Station	Fifth Station
August	7.1	6.7	7.1	7.3	7.4
September	7.3	7	7.6	7	7.1
October	7.12	6.66	7.14	7.15	7.075
November	6.8	6.4	6.7	6.7	6.7
December	6.9	6.6	6.9	6.8	7.2

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January	7	6.5	6.8	6.7	7

Body Requirement for Oxygen BOD5

The results show that the vital requirement of dissolved oxygen in the fish ponds ranges between 60-10 mg/l. The results recorded that the highest value of 60 mg/l for the vital requirement of oxygen in September in the fourth station and the lowest value of 10 mg/l in the month of August at the third station and in the month of December in the stations except for the third station and in December in the first, third and fifth station and we notice The high vital requirement for oxygen in the month of September, October and November in the five stations. The results of this study showed less values of the biological requirement of oxygen (BOD) in the waters of fish ponds under the study compared to other studies that ranged between 135 - 80 mg/L in its study [32]. For fish ponds in Tikrit, between 39-82 mg/L [33] for fish ponds. The results of the study documented a weak significant correlation ($p \leq 0.01$) between the values of the biological requirement of oxygen and the rest of the variables based on the analysis of variance test and the Dunkin' test, the results did not record significant differences between the values of dissolved oxygen in the study stations.

Table 5 Monthly and Localized Changes in Bio-Oxygen Requirement

Location / Quarter	First Station	Second Station	Third Station	Fourth Station	Fifth Station
August	50	20	10	50	30
September	20	40	40	60	40
October	30	40	30	40	20
November	35	38	35	40	25
December	10	10	30	10	10
January	10	20	10	30	10

Melted Oxygen (DO)

The results show that the concentrations of dissolved oxygen in the fish ponds range between 7.8- 3.2 mg/L, meaning that the water in the fish ponds contains enough oxygen to support the lives of fish, as it recorded the highest percentage of 7.8 mg/l in October in the fifth station and the lowest percentage 3. These results are compatible with the global standards of dissolved oxygen in fish raising, which ranges between 3-10 mg/l [34]. The results came as an approach to the results reached[35] on the effect of pollutants, an environment, parasites, fish, the Tigris River, which ranged between 4.8-8.0 mg/l, the concentrations of dissolved oxygen in the fish ponds are higher in summer and less in the winter, because high temperatures In the summer, it increases the prevalence of oxygen in the water. Oxygen dissolved at study stations.

Table 6 Monthly and Localized Changes of Dissolved Oxygen.

Location / Quarter	First Station	Second Station	Third Station	Fourth Station	Fifth Station
August	5.0	7.3	3.5	7.7	6.5

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September	4.6	6.2	6.6	7.5	7
October	4.5	6.4	6.9	7.5	7.8
November	4.8	4.5	4.1	3.8	5.2
December	3.3	3.8	6.1	3.4	4
January	3.2	3.6	6	3.2	5

Total Plate Count

The results showed that the total number of bacteria in carp ponds ranged between 53-312 CFU/ml as the highest value of 212 CFU/ml was recorded in the month of January in the second station and the lowest value of 53 CFU/ml in the month of October in the first station, which recorded the lowest percentages in all months of the study, and these results are lower than the results reached by[36]. In his study of the quality of dirt fish basins in Egypt, which ranged between 0.31 and 645.26 CFU/ML. The current study showed a remarkable increase in bacteria concentrations during the semester of the winter in the months of December and the second and the reason may be attributed to the leakage of organic material Winter, which leads to the cliff of organic materials from soil to fish basins, provides a rich source of bacteria, in addition to excessive use of organic fertilizers to increase the concentrations of organic materials in fish ponds, providing an environment suitable for bacteria reproduction [37], And the random sedimentation of organic materials, such as fish waste or environmental backgrounds, is a plastic and leaves as a source of bacterial pollutants in fish ponds[38], or bacterial pollution for fish and the deterioration of water quality resulting from the increase in the content of organic nutrients and bright pollution are all sources to increase bacteria. [39]The total number of bacteria in the summer months is due to the high temperatures, which reduces the amount of dissolved oxygen that causes the rates of bacterial growth rates[40] .

Table 7 Monthly and Localized Changes in the Total Number of Bacteria.

Location / **Quarter**	**First Station**	**Second Station**	**Third Station**	**Fourth Station**	**Fifth Station**
August	66	98	90	68	92
September	60	102	82	57	84
October	53	67	69	59	60
November	55	66	68	68	69
December	68	108	126	245	124
January	84	312	290	118	288

5. CONCLUSIONS

The results showed that there is a variation in temperatures, as the highest value of 40̊ was recorded in September and the lowest value of 13.5̊ in January, while the degree of electrical delivery recorded a remarkable increase as the highest value was 3.227 in September and the lowest value The dissolved ranged between 660 and 1860 mg/ l, with the highest value in

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November and the lowest value in August, and a sufficient amount of oxygen was available, as the values of dissolved oxygen ranged between 3.2 and 7.8 mg/ l, with the highest value in October and a low value in January, showing the number of number The overall bacteria decreased, with the highest value of CFU \ ML 312 in January and the value of 53 CFU \ ML in October. We conclude with the validity of the five fish basins for living, watering plants and suitable for animal drinking.

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