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Evaluation of some physical, chemical and bacteriological characteristics of fish ponds in Kirkuk City

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***Abstract*---**The present study aimed to conduct a field study on the water ponds in different areas of Kirkuk city. For the purpose of evaluating the water quality for four selected areas, which included water before the pond (wells water) and water inside and outside the ponds (fish ponds). December until 7/31/2021 in July. The study included measuring physical properties such as (water temperature, electrical conductivity, dissolved solids) and chemical properties such as (pH, dissolved oxygen, biological oxygen requirement, chemical oxygen requirement, total basicity, total hardness, calcium and magnesium hardness, chlorides, Sulfates, phosphates, nitrates, total nitrogen, proteins) and the percentage of bacterial contamination was also studied, which included (the total number of bacteria (Total Plate Count (TPC), the total number of Escherichia Coli Bacteria and the number of Fecal Coliform Bacteria). The results were compared with the international determinants and specifications of water standards. The results showed that the air temperature of the study sites ranged between (6-45) C, and it had a direct positive effect on the water temperature of the fish ponds, as the highest value of the water temperature reached (30) C in water inside and outside the fish ponds It turned out that the total hardness and calcium hardness were high, with the highest value reaching (1355) and (996) outside the pond, and the water was classified as very hard. The sulfate of the fish ponds exceeded the standard limits, as it reached the highest value of (5296) mg/1 of water inside the pond, and it increased in water outside the pond to reach (5358) mg/l. On the bacteriological side, they were within the permissible range for the aquatic environment and for different uses.

Keywords---fish pond water, physical and chemical characteristics, pathogenic bacteria.

Introduction

Water shortage is considered one of the main problems facing national security, especially in dry areas that suffer from water scarcity and those that are the source of water from neighboring countries, which not only increases climatic challenges but also increases threats and strategic challenges, and a lack of rainfall (Al-Safawi, 2018). As a result of the increase in the population and industrial expansion in the Kirkuk region, the demand for water has increased mainly for all uses (Uruba et al., 2020). Fisheries and aquaculture are directly linked to many of the Sustainable Development Goals and most importantly, one of the Sustainable Development Goals seeks to conserve and sustainably use the oceans, seas and water resources according to the Food and Agriculture Organization (FAO, 2018). Hence, fish pond water as wastewater and reuse is treated as one of the best alternatives to make up for water shortage. Water reuse for agricultural irrigation is often viewed as a positive way to recycle water due to the potentially large amounts of water that can be used and thus reduce the amount Water extracted from the environment (Akindele and Olufayo, 2018). Optimum fish production depends largely on the physical, chemical and biological characteristics of the water. Hence, successful management of fish ponds requires a deep understanding of water quality. The management of any water body is a key factor in the success of fish farming in it, as most of the causes of low fish growth, diseases, parasites and mortality are due to to water quality problems (Saah et al 2021). Aquarium water quality is affected by human-caused pollutants such as metals, pesticides and other chemicals that are released into the environment and eventually into water bodies. Although the most common water sources used in aquaculture and especially fish farming are wells, springs, rivers and lakes, Some people practice artificial fish farming. Usually, industrial fish farming is carried out in controlled ponds to achieve the best conditions for fish production (Mandal et al., 2017).

Materials and Methods

The process of collecting water samples from fish ponds the sampling process began in the morning and until the evening, for four selected areas of Kirkuk city starting from (the first station - Shwan) to (the fourth station - Altun copry), at a rate of three times per month at different periods, starting from December (2020) until July (2021). as the samples were collected from water inside the pond in the surface layer at a depth of 30 cm and from water outside the pond by polyethylene bottles With a capacity of 2.25 liters after washing it several times with the water to be collected, taking into account that the nozzle of the bottle is under the surface of the fish ponds water to filled the bottles with the least possible air space. As for the water before the pond (the water of the well), where the water was pumped for 15 minutes to get rid of stagnant and polluted water in order to maintain the physical and chemical properties, and it was filled with polyethylene bottles. and included measuring the air and water temperature using a mercury thermometer,use a HANNA-type (ELECTRO-CONDICTIVTY)

device to measure electrical conductivity after it has been calibrated, total dissolved solids were measured using a Digital Conductivity \ TDS Meter, the pH measured using a pH meter (Microprocessor HI 9321) made by HANNA. And measuring dissolved oxygen using DO Thermo device made in Germany. The chemical oxygen requirement for water was estimated using the diachromat method using the COD vario digester of German origin (APHA, 2012). And measuring the total hardness according to the method described in (APHA, 2003) after adding 1-2 ml of ammonia buffer solution to raise the PH value, then adding the dry detector Erichrom Black - T and then sweeping With EDTA2NA solution until the color turns blue, and the same method described in (APHA, 2003). was followed by patching with EDTA-2NA solution and adding a standard hydroxid Sodium solution at a concentration (2.5N). Then drops of Calcium Guide were added to Murexide until the color changed to blue Then calculate the magnesium ion concentration by subtracting the calcium ion concentration from the total hardness, The total alkalinity was calculated according to the method (APHA, 2005), where 100 ml was taken and two drops of Methyl Orange were added to it, and then titrated with sulfuric acid (0.02N). The chloride ion was measured by following the method described in (APHA, 2005), The method used for the determination of sulfate ions is a photometric method using the Turbidity Method (Al-Jumaily, 2015). phosphates, and nitrates were measured using a Spectrophotometer, with a wavelength of 700, 225, 275 nanometers, according to the method described in (APHA, 2003). The Keldahl method, according to the method described in (WHO, 1989), was used to measure total nitrogen, starting with the stage of digestion, then distillation, and then scaling , The percentage of protein was calculated from the nitrogen multiplied by the parameter 6.25 to extract the percentage of crude protein, Van Dijk (2000). As for the bacteriological examinations, the method described in(APHA, 2005). was used in calculating the total number of bacteria (TPC) using the standard plate count expressing the unit CFU/ml and calculating the total number of coliforms by the method of the most probable number and the multiple tubes method according to (Brown, 2007). where three groups were inoculated, and each group consisted of five 25 ml test tubes containing the two-concentration liquid culture medium Lauryl tryptose broth in the five tubes. The tubes were inoculated with water samples with a sterile pipette, then (0.1,1,10) ml of sample water was injected, and placed The Durham, s tube is inverted, then the tubes are gently shaken and incubated at (35-37) C o for a period of 24-48 hours. At the end of the 48-hour incubation period, each tube is examined for the presence of any growth or gas in the Durham, s tubes tube. Confirmed test to ensure that the bacteria had fermented the culture medium with the previous test and the production of gas. A full loop drop was transferred from the positive tubes that produced the acid and gas to 5 tubes containing the culture medium Brilliant Green lactose broth (BGB) and incubated at (35-37) C o . for a period of 24-48 hours, then each tube is examined to detect the presence of gas after the end of the 48- hour incubation period and the results are recorded, then the Completet Test was performed. The Taoist On the medium of (BGB) and incubated at 35 C o in an inverted manner, it is observed that small circular colonies are formed in an opaque color indicative of the colony's relevance to the intestinal family, then the total number of Fecal coliform Bacteria (FC) was calculated, where the same steps were followed to calculate the total number of coliforms as the tubes were inoculated It was incubated at 44.5 C o in the water bath for 48 hours. The number of tubes that

formed the acid and gas was calculated according to(Anochie et al .,2018). Then a supplementary test was performed for the colonies suspected of being pure E. coli developing on (EMB) and Pepton water medium to examine the formation of ondole. The tubes were incubated in a 44.5 degree water bath for 24-48 hours, since at this temperature the fecal coliform bacteria grow according to(APHA, 2003).

Results and Discussion

Temperature

The temperature of water is of great importance in the life of living organisms, It is a major factor affecting the vitality and production of fish as they are cold-blooded ,the results of the study recorded the highest level of water temperature of 30 ° C inside and outside the ponds in the months of June and July, while the lowest water temperature was 10 ° C inside and outside the ponds in January and February. Therefore, it was classified within the warm waters (Kanna, 2006). The reason for the low temperatures in the water of fish farms in winter is due to its effect on the surrounding air temperature (Mashaykhi, 2016).

Table 1: The highest and lowest and average value of water temperature during the study period

T. C °	water before the pond		water inside the pond		water outside the pond	
	H	L	H	L	H	L
Shwan	25	22	29	10	30	10
Daquq	23	20	30	11	30	10
laylan	24	20	30	10	29	14
Altun copry	25	10	28	10	27	10
R	24.25	18	29.25	10.25	29	11

The months of research are from December2020, January, February, March, April, May, June and July2021.

Electrical conductivity

The rates of electrical conductivity ranged between (1099.75-901) microsimens / cm in water outside the pond and these results came close to the results reached by (Al-Badri, 2012) The high values in fish pond water may be due to the use of natural manure to fertilize ponds and feed fish in ponds to an increase in total dissolved solids and ionic concentration (Ngugi et al., 2019). The Pearson correlation coefficient recorded a positive significant correlation with total dissolved solids with a value of $r = 99^{++}$ at the level of significance $P \leq 0.01$, which shows the positive relationship between them.

Table 2: The highest, lowest, and average of the electrical conductivity of water during the study period

E.C	water before the pond		water inside the pond		water outside the pond	
µs/cm	H	L	H	L	H	L
Shwan	290	258	450	160	456	258
Daquq	2452	2122	2503	2160	2500	2165
laylan	1090	905	1068	889	1073	890
Altun copry	400	230	373	270	370	291
R	1058	878.75	1098.5	869.75	1099.75	901

The months of research are from December2020, January, February, March, April, May, June and July2021.

Total dissolved solids

The concentration rates of total dissolved solids ranged between (925.5-715) mg / liter, with the highest value (2155) mg / liter recorded in the month of April and the lowest value (150) mg / liter in the month of December, and where the water of the current study was classified as low Salinity, according to the water quality classification table based on total dissolved solids (Todd ،2007) .The Pearson correlation coefficient recorded a positive significant correlation with TDS, salinity, electrical conductivity, total hardness, calcium hardness, magnesium hardness, chlorides and sulfates at the level of significance P≤0.01. The reason for the decrease in the values of total dissolved solids in the water of fish ponds in the study stations is due to the continuous water exchange, which leads to a reduction in the concentration of salts in it, and this is consistent with the interpretation of (Al-Janabi, 2020). As for the high values inside fish ponds, it is due to the dry climate, which affects the increase in the solubility of salts and the increase in evaporation rates and the decomposition of compounds due to high temperatures (Al-Qusayr, 2012).

Table 3: The highest, lowest, and average values for total dissolved solids in water during the study period

T.D.S	water before the pond		water inside the pond		water outside the pond	
	H	L	H	L	H	L
Shwan	240	220	370	150	375	155
Daquq	2130	1910	2140	1760	2155	1790
laylan	840	830	860	720	867	743
Altun copry	350	320	332	230	263	238
R	890	820	925.5	715	915	731.5

The months of research are from December2020, January, February, March, April, May, June and July2021.

PH

The studied pH values for water ranged between 9.8 as the highest value recorded inside the pond in shwan of the month of December, and 6.7 as the lowest value calculated in water before the pond in shwan of the month of April. The results were in agreement with the results of (Kazim, 2020) in his study of the effect of the density of culture of carp fish in ponds, the values of which ranged between (6-9.5). The extent of the difference in pH values in the water before the pond was small and had little fluctuation in its values. The reason for this is attributed to the water's ability to have an acid neutralization capacity and to soils rich in bicarbonate and carbonate salts (Kevat et al., 2016). As for the water of fish ponds, the limits of the results are within the appropriate limits for fish farming, which range between 6.5-9 as mentioned (Horvath et al., 1992).

Table 4 : The highest, lowest and average pH value

PH	water before the pond		water inside the pond		water outside the pond	
	H	L	H	L	H	L
Shwan	7.6	6.7	9.8	7.0	9.0	7.1
Daquq	7.5	6.9	8.3	6.9	7.4	7.0
laylan	7.6	7.1	8.1	7.7	7.7	7.2
Altun copry	7.6	7.1	8.8	7.4	8.2	7.2
R	7.57	6.95	8.75	7.45	8.07	7.12

The months of research are from December2020, January, February, March, April, May, June and July2021.

Dissolved Oxygen (D.O)

The results of the study indicated that the values of dissolved oxygen increased in the winter and decreased in the summer. We note through the results a decrease in the values of dissolved oxygen in water inside and outside the fish ponds and its increase in the water before the ponds, and this is consistent with the study (Fadaeifard et al., 2012) the reason for its decrease in The water of the fish ponds compared to the water before the pond is due to the overcrowding of fish, as the demand for oxygen increases with the increase in the density of fish, the increase in the excretion of wastes and the increase in fertilization of the ponds (Mikheev et al., 2014)). The results are consistent with the global limits of dissolved oxygen (Bhatnagar and Devi, 2013) accepted for fish farming standards, which are not less than 3 mg / liter and not more than 10 mg / liter.

Table 5: The highest, lowest and average values of dissolved oxygen in water during the study period

(D.O)	water before the pond		water inside the pond		water outside the pond	
	H	L	H	L	H	L
Shwan	7.9	7.0	7.5	6.1	7.4	6.0

Daquq	7.7	6.2	7.2	6.2	7.2	6.1
laylan	8.2	6.4	7.2	6.3	7.4	6.0
Altun copry	8.7	6.2	7.8	6.0	7.8	6.1
R	8.12	6.45	7.42	6.15	7.45	6.05

The months of research are from December2020, January, February, March, April, May, June and July2021.

Biological oxygen Demand

The biological requirement of oxygen is used in estimating the percentage of organic pollution and in evaluating the process of self-purification of water. The high value of this indicator indicates the presence of organic pollution in the aquatic environment, as the BOD values are directly proportional to the degree of pollution and temperature (Hassan, 2013). The BOD levels were between (0.2-85) mg / L. We note through the results that the BOD values increased in the month of December in the water inside and outside the fish ponds of the four stations, which may be due to the rainy season, which causes the arrival of organic materials and micro-organisms into the ponds, as well as the flow of organic fertilizers that are used to increase the productivity of the agricultural lands near the ponds, as well as the flow of waste residues Animal husbandry (Owamah, 2020). The Pearson correlation coefficient showed a positive significant correlation between BOD, COD, phosphate and the total number of bacteria, coliform bacteria and faecal coliform bacteria, respectively, at the level of significance $P \leq 0.01$.

Table 6: The highest, lowest and average BOD values for water during the study period

BOD_5 mg / l	water before the pond		water inside the pond		water outside the pond	
	H	L	H	L	H	L
Shwan	16	0.2	89	24	85	25
Daquq	18	11	35	16	42	22
laylan	13	0.2	52	20	57	15
Altun copry	12	0.2	82	9	85	10
R	14.75	2.9	64.5	17.25	67.25	18

The months of research are from December2020, January, February, March, April, May, June and July2021.

Chemical oxygen Demand

The highest value was 215 mg/liter in water outside the pond in Shwan in April, and the lowest value was 10 mg/liter in water outside the pond in Laylan in January. We note from the results that the values of the chemical oxygen requirement in the water inside and outside the fish ponds increased in all months on the water before the aquarium, and this is consistent with the results of (Akindele and Olufayo, 2018). It indicates a rise in the values of COD in the

month of December and January in the four water stations of the ponds. The presence of a high degree of pollutants and aquaculture activities may be due to the rainy season (Jeyara et al., 2014). The recommended limits of COD values for aquariums are 100 mg/L (DAO, 2016). Pearson's correlation coefficient showed a significant direct correlation between COD and BOD, pH, phosphate and total number of bacteria, respectively, at the level of significance P≤0.01.

Table 7: The highest, lowest and average COD values for water during the study period

COD mg / l	water before the pond		water inside the pond		water outside the pond	
	H	L	H	L	H	L
Shwan	59	17	200	128	215	135
Daquq	43	16	114	45	120	89
laylan	96	12	140	10	155	23
Altun copry	30	11	188	41	197	56
R	57	14	160.5	56	171.75	75.75

The months of research are from December2020, January, February, March, April, May, June and July2021.

Total Alkalinity

The results of the study showed an increase in the basic values of water before the pond, and the results were similar to the results of (Abd al-Rahman, 2010) in his study of the physical, chemical and biological properties of fish ponds in Egypt. The increase in the base values in the water before the pond may be due to the geological formations of the studied areas and according to the source of the bicarbonate and carbonate ions in the water, as their source in groundwater is limestone in contact with water, as well as the presence of Co2 due to rain while passing through the geological formations (Navien et al., 2017). The high basal values may be due to the proximity of the ponds to residential areas and its pollution with sewage water, in addition to the metabolic products of aquatic organisms that cause an increase in Co2 (Al-Obaidi, 2019). The results of the current study came within the acceptable range of fish farming according to (WHO, 2009), as the value Permitted for aquatic environment 600 mg/L.

Table 8: The highest, lowest, and average value of the total base water during the study period

T.Alk mg/l	water before the pond		water inside the pond		water outside the pond	
	H	L	H	L	H	L
Shwan	335	141	445	93	445	90
Daquq	392	144	277	116	260	120
laylan	671	280	455	125	467	154
Altun copry	360	120	283	124	287	122
R	439.5	171.2	365	114.5	364.75	121.5

The months of research are from December2020, January, February, March, April, May, June and July2021.

Total hardness

The study showed an increase in the values of the total hardness in winter, as the highest value of the total hardness was 1355 mg / liter in water outside the fish ponds in Daquq for the month of December, and the lowest value was 206 mg / liter in the water before the pond in Shwan for the month of April. The results were similar to the results of (Al-Mashaikhi, 2016). The reason for the increase in the values of total hardness in the wet season may be due to the increase in the solubility of salts to calcium and magnesium ions and to the high percentage of total salts caused by adding fertilizers to the neighboring agricultural lands that drift as a result of rain, causing an increase in hardness (Hamed, 2021). Pearson's correlation showed a significant direct correlation Between the total hardness, calcium hardness, magnesium hardness and sulfate at the level of significance P≤0.01. The study water was classified as very hard water according to the classification of (Todd, 2005).

Table 9: The highest, lowest, and average value of total hardness in water during the study period

T.H mg/l	water before the pond		water inside the pond		water outside the pond	
	H	L	H	L	H	L
Shwan	624	206	409	271	432	320
Daquq	1259	646	1330	721	1355	743
laylan	928	664	1211	484	1232	456
Altun copry	782	400	570	282	584	287
R	898.25	479	880	439.5	900.75	451.5

The months of research are from December2020, January, February, March, April, May, June and July2021.

Calcium hardnes

The results of the study showed the highest value of calcium hardness (996.12 mg/L) in water outside the fish ponds, and the lowest value was (121.62 mg/L) in water before the pond. The results of the study were less than the results obtained by (Jawad et al., 2021) in his study of trace elements in fish ponds in Karbala, which reached the calcium hardness values (1001-1301) mg / liter. The high calcium values may be attributed to the nature of the lands that make up 30.23% of gypsum soils and sedimentary rocks (Al-Obaidi, 2010). The Pearson correlation coefficient showed a significant direct correlation between calcium hardness, total hardness, magnesium hardness, salinity, electrical conductivity, TDS, chlorides, sulfates and total number of bacteria at a level of significance P≤0.01, which indicates a direct relationship between these factors with calcium.

Table 10: The highest, lowest, and average calcium hardness values for water during the study period

Ca.H mg/l	water before the pond		water inside the pond		water outside the pond	
	H	L	H	L	H	L
Shwan	342.82	121.63	252.32	149.32	238.21	158.89
Daquq	925.23	365.23	992.47	358.27	996.12	396.63
laylan	485.56	300.65	589.65	250.51	885.65	255.52
Altun copry	392.78	250.65	322.65	202.08	336.23	204.02
R	536.59	259.54	539.27	240.04	614.05	253.76

The months of research are from December2020, January, February, March, April, May, June and July2021.

Magnesium hardnes

The results of the study showed the highest value recorded for hardness of magnesium 517.35 mg / liter in the water before the pond for the month of December, and the lowest value was 72.88 mg / liter in the water before the pond for the month of June. The results showed an increase in the magnesium values in water before the basin compared to water inside the fish ponds in most months of the study.The reason for the discrepancy in the concentration of magnesium in fish pond water may be due to adding magnesium supplemented feed to fish pond water to avoid magnesium deficiency, as magnesium deficiency inhibits fish growth and harms the structural and intestinal integrity of fish (Wei et al., 2018.) Magnesium values exceeded the limits Permitted for the aquatic environment according to the instructions of the World Health Organization (WHO, 2004) and the Iraqi standard limits for the year 1996, whose magnesium hardness values range from 50-125 mg / liter.

Table 11: The highest, lowest and average values of magnesium in water during the study period

Mg.H mg/l	water before the pond		water inside the pond		water outside the pond	
	H	L	H	L	H	L
Shwan	231.18	72.88	198.79	113.69	233.72	114.79
Daquq	406.31	258.68	385.73	241.82	385.31	251.31
laylan	517.35	111.16	358.68	206.65	346.35	206.44
Altun copry	491.46	103.04	247.35	77.98	250.76	82.98
R	411.57	136.44	297.63	160.03	304.03	163.88

The months of research are from December2020, January, February, March, April, May, June and July2021.

Chloride ion

Chloride is one of the indicators of water salinity, and the degree of salinity depends on its association with calcium and magnesium ions (Nag and Das, 2017). The results of the study were (6-133) mg/l. The results were less than (Wali, 2020) in his study on the factors affecting the death of fish in the Diwaniyah River in southern Iraq. The presence of discrepancies in chloride values may be due to the continuous additions of hydrochloric acid to fish ponds, from which the chloride ion is released (Rip et al., 2005). The relative increase in chloride concentration during the hot period may be due to the high rate of evaporation and to the effects of irrigation water that cause the washing of neighboring soils, in addition to the leakage of organic pollution factors and the increase in the concentration of dissolved salts, which are characterized by their tendency to melt at high temperatures (Shawat, 2016). The results of the study fall within the permissible limits for fish farming, as most types of freshwater fish have the ability to tolerate 300 mg / liter of chlorides (Holmes, 1996). There is no problem with the toxicity of chlorides to the wastewater of fish ponds in drinking animals, livestock and irrigation (Khasaf and Afrah, 2015).

Table 12: The highest, lowest and average value of chloride in water during the study period

Cl mg/l	water before the pond		water inside the pond		water outside the pond	
	H	L	H	L	H	L
Shwan	18	6	83	14	85	16
Daquq	100	81	120	84	133	86
laylan	62	50	78	54	78	50
Altun copry	29	11	57	8	58	21
R	52.25	37	84.5	40	88.5	43.25

The months of research are from December2020, January, February, March, April, May, June and July2021.

Sulfates ion

The results showed a noticeable increase in sulfate values, as the highest value reached (7403 mg/L) in the water before the pond for the month of December, and the lowest value was (30 mg/L) in the water inside the pond for the month of January. It may cause the dissolution of copper sulfate and lime materials added as disinfectants to water Fish ponds have high levels of sulfate and that a large group of fish tolerate sulfate concentrations to levels up to 500 mg/L (Rasool, 2018), as well as biodegradation processes of organic matter and protein materials (Egbueri et al., 2019). The results of Pearson's correlation coefficient showed the presence of Significant positive correlation between sulfate, electrical conductivity, salinity, TDS, total hardness, calcium hardness, magnesium and chlorides at the level of significance $P \leq 0.01$.

Table 13: The highest, lowest and average values of sulfate in water during the study period

So_4 mg/l	water before the pond		water inside the pond		water outside the pond	
	H	L	H	L	H	L
Shwan	191	35	389	30	397	36
Daquq	7403	545	5296	680	5358	106
Laylan	2149	400	1952	382	1943	384
Altun copry	457	83	650	135	660	142
R	2550	265.75	2071.75	306.75	2089.5	167

The months of research are from December2020, January, February, March, April, May, June and July2021.

Nitrates ion

The results showed a discrepancy in nitrate values, with the highest value reaching (31 mg/L) and the lowest value (5 mg/L). The results were similar to the results of (Umeh et al., 2020) on his study of the water quality of fish ponds in Nigeria, whose nitrate values were (3.6-28.0) mg/ l. The results showed an increase in the nitrate values in the water before the pond every month over the water of the fish ponds, and this is due to the main sources of water pollution with nitrates, which include agricultural fertilizers, human and animal waste, and sewage effluents that raise the values of nitrates (Al-Saffawi and Awad., 2020). The reason for the difference in nitrate concentrations in the water of fish ponds is the result of fish residues containing high percentages of urea and ammonia, as well as the amount of nitrogen resulting from the decomposition of protein from fish feed (Al-Omar, 2010). The results came within the permissible limits of the aquatic environment for nitrates, according to (WHO , 2006) that the values do not exceed 50 mg /l, and it is suitable for watering animals and livestock that the values of nitrate do not exceed 100 mg/l (Socha et al., 2003).

Table 14: The highest, lowest and average value of Nitrates in water during the study period

No_3 mg/l	water before the pond		water inside the pond		water outside the pond	
	H	L	H	L	H	L
Shwan	23	21	22	7	24	10
Daquq	28	25	17	11	18	11
Laylan	21	18	11	6	15	9
Altun copry	31	5	17	10	18	11
R	25.75	17.25	16.75	8.5	18.75	10.25

The months of research are from December2020, January, February, March, April, May, June and July2021.

Phosphates ion

The results of the study showed the highest value recorded 1.18 mg / liter in water outside the aquarium and the lowest value recorded 0.001 mg / liter in water before the aquarium. The percentage of phosphate has increased inside and outside the fish ponds compared to the water before the pond. The increase in the degree of organic pollutants and the organic load inside the ponds contributes to the increase in phosphate concentrations (Stavescu-Bedivan et al., 2017). Perhaps this is confirmed by the Pearson correlation coefficient for pond water in the presence of There is a significant direct correlation between phosphate and the biological oxygen requirement BOD and the chemical oxygen requirement COD at a significant level of P ≤0.01. The results were appropriate for fish farming, as indicated by (Bhatnaga and Devi, 2013) to the proportion of phosphate suitable for fish farming which is 2-0.03 mg/L.

Table 15: The highest, lowest and average values of phosphates in water during the study period

Po_4 mg/l	water before the pond		water inside the pond		water outside the pond	
	H	L	H	L	H	L
Shwan	0.51	0.001	1.16	0.02	1.18	0.03
Daquq	0.100	0.001	0.98	0.18	0.95	0.09
Laylan	0.18	0.002	0.55	0.085	0.43	0.04
Altun copry	0.13	0.001	0.49	0.06	0.50	0.07
R	0.23	0.001	0.79	0.086	0.76	0.05

The months of research are from December2020, January, February, March, April, May, June and July2021.

Totale Nitrogin

The results of the study showed the highest value of nitrogen (8.5 mg/l) in the water before the pond, while the lowest value was (1.4 mg/l) in the water outside the pond. The results were less than (Akindele and Olufayo, 2018) in his study of water before and inside fish ponds and the use of Waste water of fish ponds for plant irrigation in Nigeria, as the values of total nitrogen amounted to (5-17) mg / liter. The results show an increase in nitrogen values in fish ponds over water before fish ponds, starting from April, May, June and July, due to the increase in the amount of feed intake, the increase in lumpy organic matter and suspended solids, and the increase in organic decomposition processes during this period (Nagy et al., 2017).

Table 16: The highest, lowest and average values of Totale Nitrogin in water during the study period

T.N mg/l	water before the pond		water inside the pond		water outside the pond	
	H	L	H	L	H	L
Shwan	8.5	0.5	8	1.9	8.3	1.4
Daquq	6.8	2.8	6	2.1	6.3	3.1
Laylan	8.1	2	8.1	3.2	8.5	3.9
Altun copry	6.8	4.3	6.9	2.2	6.5	2.2
R	7.55	2.4	7.25	2.35	7.4	2.65

The months of research are from December2020, January, February, March, April, May, June and July2021.

Proteins

The results of the study showed the highest value of proteins (53.1) mg/l in the water before and outside the pond for the months of December and January, respectively, while the lowest value for proteins (3.1 mg/l) in the water before the pond for the month of April. The results were higher than (Zhao et al., 2021) in their study of the concentration of protein in the water of the earthen ponds of the multiple system of fish farming in China, whose protein values reached (1.05-1.74) mg/l. The high levels of protein are attributed to the enrichment of water with nutrients and the amount of feed. Which contains high levels of crude protein (Hassan et al., 2017). Studies have confirmed the importance of fish ponds drainage water for plants because of its high content of protein and nitrogen materials necessary to increase crop production, as fish waste contributes to improving soil fertility and fertilizing the land because it is considered an organic fertilizer (Kazim, 2020).

Table 17: The highest, lowest and average values of Proteins in water during the study period

Proteins mg/l	water before the pond		water inside the pond		water outside the pond	
	H	L	H	L	H	L
Shwan	53.1	3.1	50	11.8	51.8	8.7
Daquq	42.5	17.5	37.5	13.1	39.3	20
Laylan	50.6	12.5	50.6	20	53.1	24.3
Altun copry	42.5	26.8	43.1	13.7	40.6	13.7
R	47.17	14.97	45.3	14.65	46.2	16.67

The months of research are from December2020, January, February, March, April, May, June and July2021.

Bacteriological examinations
Total plate count (TPC)

Bacteria are among the most common pathogens that infect warm-water, farmed fish. It is also the most prevalent cause of disease and death in wild fish populations (Kassa and Mitiku, 2021). The results of the study showed the highest value for the total number of bacteria (398 CFU/ml) in water outside the pond in February, while the lowest value was (10) CFU/ml in water before pond for the month of May and April. The reason for the high values inside and outside the fish ponds in winter in the months of December, January and February for the four stations may be due to the leakage of organic matter as a result of rain and the continuous fertilization of the ponds (Macedo et al., 2011). And that the bacterial contamination of fish is due to the deterioration of water quality due to deteriorating environmental conditions, which causes stress and secondary bacterial infections of fish resulting from the increase in the content of organic nutrients and fecal contamination (Silas and Alagoa, 2021). Perhaps what is confirmed by the statistical analysis of Pearson's correlation coefficient for pond water in the presence of a significant direct correlation between the total number of bacteria, COD, BOD, fecal coliform bacteria, phosphate, nitrogen, protein, calcium hardness and pH at a significant level of P≤0.01 and with total hardness at a significant level of P≤ 0.05.

Table 18: The highest, lowest and average values of the total number of bacteria in water during the study period

TPC CFU/L	water before the pond		water inside the pond		water outside the pond	
	H	L	H	L	H	L
Shwan	57	33	350	52	390	63
Daquq	87	17	310	65	398	78
Laylan	56	10	310	68	378	77
Altun copry	160	32	337	58	350	76
R	90	23	326.75	60.75	379	73.5

The months of research are from December2020, January, February, March, April, May, June and July2021.

Total coliform Bacteria (FC) count

The presence of fecal coliforms in the aquatic environment indicates water contamination with human, animal and bird waste, including Escherichia coli, as its detection is one of the signs of fecal contamination (Gwimbi et al., 2019). The highest value was (82) cells/100ml in water outside the pond for the month of December, and the lowest value was (0) cells/100ml in water before the pond. Livestock activities such as grazing that develop around fish ponds can lead to an increase in faecal coliforms, as there are livestock houses that are one of the largest sources that cause high levels of faecal bacteria (Islam et al., 2017). The wastewater of fish ponds was classified as excellent. It is non-polluting and satisfactory to aquatic life according to the permissible quality limits set by (Conagua, 2015) for the water of fish ponds that the values of faecal bacteria

should be less than (100) cells / 100 ml, as it is acceptable for irrigation and for drinking animals.

Table 19: The highest, lowest, and average value of faecal coliform bacteria in water during the study period

FC cell/100ml	water before the pond		water inside the pond		water outside the pond	
	H	L	H	L	H	L
Shwan	12	0	64	2.0	82	3.3
Daquq	11	0	27	3.0	39	4.2
Laylan	14	0	90	8.6	98	9.4
Altun copry	17	0	26	4.8	33	6.9
R	13.5	0	51.75	4.6	63	5.95

The months of research are from December2020, January, February, March, April, May, June and July2021.

Escherichia Coli Bacteria

E.coli bacteria is one of the pathogens that cause types of infections to humans and animals that spread in feces and contamination of water and soil. The presence of Escherichia coli in water increases the likelihood of the presence of pathogenic intestinal bacteria such as Shigella and Salmonella and viruses (Mienkovic et al., 2017). The results of the study showed the highest value of (83) cells/100ml in water outside the ponds for the month of December, and the lowest value recorded (0) cells/100ml in water before the pond for the month of December. The results showed a decrease in the values in the water before the pond compared with the water inside and outside the fish ponds, and this is consistent with the study of (Ko et al., 2021) in his study of the quality of well water and the water of fish ponds in China. The results showed the high values of fish pond water due to the use of animal manure by most fish farmers to feed fish (Ko et al., 2021). The water before the ponds is suitable for all uses and for fish farming, with the drainage water of fish ponds suitable for irrigation and for drinking animals and livestock, according to the World Health Organization (WHO, 2005) for the safe use of water that does not exceed the total number of coliform bacteria (10) cells / 100 ml, except for the drainage water of the basins in Shwan and Alton copry for the month of December and Laylan for the month of January.

Table 20: is the highest, lowest, and average value for the total number of Escherichia Coli Bacteria in water

E.coli cell/100ml	water before the pond		water inside the pond		water outside the pond	
	H	L	H	L	H	L
Shwan	4.0	0	70	2.0	83	4.0
Daquq	2.3	0	6.8	4.5	6.8	9.1
Lylan	2.3	0	69	1.2	73	1.2

Altun copry	3.7	0	17	2.0	20	3.0
R	3.07	0	53.95	2.42	45.7	4.32

The months of research are from December2020, January, February, March, April, May, June and July2021.

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