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EVALUATION OF THE VALIDITY OF AGRICULTURAL DRAINAGE WATER FOR THE BREEDING OF COMMON CARP FISH IN ARTIFICIAL PONDS, IRAQ

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Abstract

The study was conducted on the water of agricultural drainage, (The main drain in Iraq) Al-Masab Al-Ahim and one of the main drain branches of it (Al-Yusufiyah drainage), a collector drainage and a branch drainage in the northern section of the Al-Masab Al-Ahim in the south-west of Baghdad 40 km. The study lasted for 12 months from August 2017 to July 2018. The study included a number of physical and chemical factors such as water temperature, dissolved oxygen, biochemical oxygen demand, pH, total dissolved solids, total hardness and quantity of chlorophyll-a. The study also studied plant nutrients such as nitrate, nitrite and phosphates. And some of the heavy metals such as lead, cadmium, chromium, and copper. The bacterial study included: Total Coli forms, *E. coli* and Fecal coliform. Some of which were among the permitted standards globally, others have exceeded those standards. The result of statistical analysis shows large differences mostly at the probability level P> 0.05.

Keywords: Agricultural drainage, fish, heavy metals, nutrients, bacterial contamination.

Introduction

Fish is the most important food source for humans since ancient times as an important protein and many nutrients sources, but because an increasing number of the population, over fishing and pollution of water and bridging the needs of local market of fresh fish to search and find an alternative, from here it emerged the importance of and the need for development in the fish farming process by using the latest technical means to provide food security (Mohammed, 2010). Fish farming is the most common form of aquaculture, the main types of fish used in breeding are carp, salmon, catfish and tilapia (FAO, 2018; UN FAO, 1987). Fish meat is characterized by low calories and cholesterol and contain high levels of protein, and can convert a high percentage of feed material for meat as well as the possible breeding large numbers of them intensively in small areas of land and small amounts of water (Bimal, 2015). Iraq has a large number of aquatic ecosystems as inland waters cover approximately 24,000 km^2, which are rivers, lakes, reservoirs, marshes, streams, springs and water drainage and irrigation canals, as well as ground water (Al-Saadi, 1994). The agricultural drainage water containing many organic pollutants and chemical pesticides, fertilizers, heavy metals so it must control these pollutants as a condition for use in fish farming, where it can accumulate these contaminants through the food chain (Mahmoud and Farouk, 2015). Despite the existence of this huge number of diverse water sources in Iraq, but the scarcity of water due to the lack of rain and the fact that the bulk of the sources of our water from outside the Iraqi territory, which is controlled by the neighboring countries and also because of the expansion of fish farming in the last ten years has made the Iraqi farms resort to thinking using water drainage in fish breeding.

Materials and Methods

Study Area

The study was conducted on the water of agricultural drainage in the area of Yusufiya, southwest of Baghdad, 30 km. The main drain in Iraq (called the Al-Masab Al-Ahm) passes through, which is connected to a large network of main, collectors and branched drainages. Four sampling sites were selected, the first from the Al-Masab Al-Ahm, the second from the Yusefiyah drainage, the third from one of the collector's drainage branching from the Yusefiyah drainage and the fourth from branch drainage.

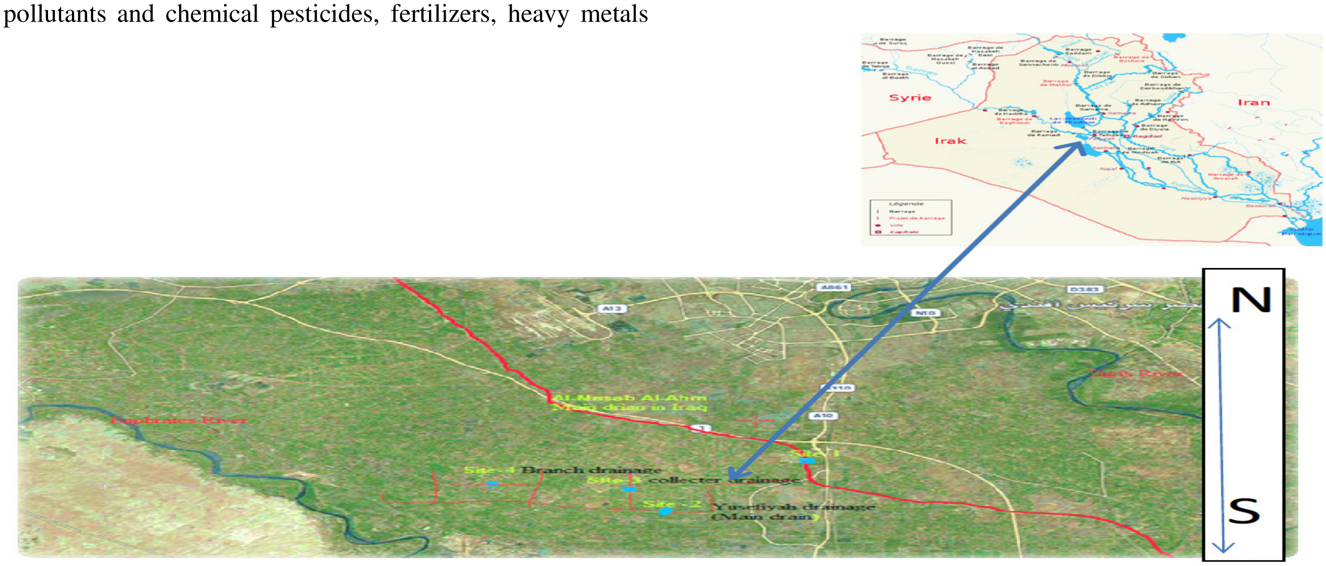

Fig. 1 : A map showing the study stations

Sampling

Samples were collected from all study sites monthly starting from August 2017 until July 2018, from the surface layer in the depth of 20-30 cm high and from the middle of the drainage through the containers of polyethylene, capacity of 5 liters and then transferred to the laboratory for the analysis of chemical, Some measurements were made in the field directly such as temperature, pH, TDS, DO and EC, As for the microbiological tests, the samples were collected using sterile glass bottles and transferred to the laboratory using a fliny box that contained enough ice to maintain the properties of the sample until it reached the laboratory, The tests were carried out according to the methods approved by (APHA, 2005)

Statistical analysis

The differences between the study sites were determined for the factors measured in the variance analysis method using the SAS statistical program.

Result and Discussion

Physical and chemical properties of water drainage

The water temperature ranges between 0-35 m, depending on the source and river depth, the season, geographic location. Temperature affects most of the physical and chemical properties of water, such as density, specific gravity, viscosity, surface tension and thermal capacity solubility of gases, salts, electrical conductivity chemical and biochemical reactions (Nizam and Mohammed, 2014). The water temperature values in the present study ranged from the highest values of 29 °C in the summer to the lowest of 11 °C in the winter. This is within the internationally accepted limits for aquatic life as in table 1.

The level of dissolved oxygen (DO) present in lakes and streams is commonly used as an indicator of water quality. Maintaining adequate concentrations of DO is vitally important for supporting fish, invertebrates and other aquatic life. Like people, fish and other aquatic organisms need oxygen to live.In addition to being required by aquatic organisms for respiration, oxygen is necessary to help decompose organic matter in the water and bottom sediments. It is also necessary for other biological and chemical processes (Washington State Department of Ecology, 2002). Mean values of dissolved oxygen were acceptable compared to global determinants, while Biological Oxygen Demand (BOD) is often used as a surrogate of the degree of organic pollution of water (Clair *et al.,*2003.), the results of BOD were within internationally acceptable limits, as a table 1.

The pH affects the ability of aquatic organisms and fish to regulate basic life-sustaining processes, primarily the exchanges of respiratory gasses and salts to the water in which they live. Failure to adequately regulate these processes can result in numerous sublethal effects and lethal in cases when the ambient pH exceeds the range physiologically tolerated for aquatic organisms (RBI, 2004), the pH values were within the universally accepted ranges, ranging from the lowest value of 6.8 and the highest value of 8.5, as in table 1.

Total dissolved solids (TDS) refers to the amount of minerals, metals, organic material and salts that are dissolved in a certain water volume that is expressed in mg/L. (Phyllis and Lawrence, 2007), In the current study, the values of total soluble solids were fairly high compared to global determinants, if ranges ranged between 900-1880 mg / L see Table 1 .

Water hardness is important to fish culture . It is a measure of the quantity of divalent ions such as calcium, magnesium and iron in water. There are many different divalent salts; however, calcium and magnesium are the most common sources of water hardness (William, 1993). In the present study, the values of total hardness were high, exceeding the global determinants, with ranges ranging from 324-732 mg / l.

The existing of the chlorophyll a concentration in phytoplankton and the phytoplankton spectra reflectance is related to the optical activity of the pigment, the composition and appearance of the algal cells. Chlorophyll, in various forms, is bound within the living cells of phytoplankton found in surface water. Chlorophyll is an important pigment in marine and freshwater algal species and has always been used as an indicator for phytoplankton biomass as well as bio-production calculation in water bodies (Duan *et al.,* 2010), ranging evaluation of chlorophyll-a between the lowest value was 1.93 mg / L and the highest value was 8.64 mg / L

Nutrients

Nitrate is not readily adsorbed onto soil colloids and thus it is present in soil solution and readily leached with water (Phil *et al.,* 2003). Nitrate values ranged between 0.135-3.423 mg/l observations within acceptable limits to international standards. Nitrite is widely consumed from the diet of animals and humans. However the largest contribution to exposure results from the in vivo conversion of exogenously derived nitrate to nitrite. Because of its potential to cause to methaemoglobin (MetHb) formation at excessive levels of intake, nitrite is regulated in feed and water as an undesirable substance (Andrew *et al*., 2013). Elevated nitrite concentrations cause great problems in intensive culture of commercial fish species (Dvorak, 2004). Nitrite rates in the current study ranged from 0.177-0.287 mg/l higher than the internationally permissible limits , phosphorus is one of the most essential minerals for fish growth and bone mineralization which function primarily as a structural component of hard tissues e.g., bone, exoskeleton, scale and teeth. The effects of dietary phosphorous deficiency in fish have been found mainly to be loss of appetite, reduced growth and head and skeletal deformities and under extreme circumstances affect bone formation and lead to death of fish (Lall, 1979) Phosphate values were slightly higher than those allowed in river water as in table 1.

Heavy Metals

The heavy metals are importance pollutants in the aquatic network because of their toxicity, accumulation and bio-magnification by food chain. Domestic, industrial and anthropogenic activities may broadly become the source of natural aquatic systems, contamination of heavy metals (Lall,1979). Heavy metals have been associated with many fish deformities in natural populations and in a laboratory produced specimens as well. Deformities in general have devastating effects on fish populations since they affect the survival, the growth rates(Velez and Montoro,1998).

The toxic effect of heavy metals in multidirectional fish is reflected in many changes in the physiological and chemical processes of the body systems. Secondary toxicity of lead in fish produces blood and neurological effects, leading to premature mortality of mature red blood cells and inhibition of hemoglobin formation by inhibition of red blood cells, the result is anemia. In the high lead, neurological, and impaired learning behavior, lead can also affect glucose metabolism. A strong response to hyperglycemia was observed in fish exposed to other metals, such as cadmium and copper (WHO, 1995; Martinez et al.,2004). Heavy metals are poisoned by fish. They can effectively affect vital processes and fish reproduction. Weaken the immune system, and produce a satisfactory appearance. As such, it is therefore possible to use fish as biomarkers, play an important role in controlling the contamination of heavy metals (Authman *et al.,* 2015).

The values of lead, cadmium and chromium exceeded the limits allowed globally, while the values copper were within the permissible limits, as in table 3.

Bacteriological tests

The WHO has recorded that up to 80% of all diseases in the world is caused by polluted water and inadequate sanitation. Also, the same source listed the disease related to unsafe water supplies low hygiene and sanitation controls like food poisoning which caused by *E. coli* and *Salmonella spp.* (Hassan *et al.,*2016). The results of the study showed a large number of species of bacteria studied, which is an indicator of pollution of human and organic waste, where they spread in the study area, animal and poultry breeding, there is also no sewage network in the area, forcing residents to dump their waste into the sewer network as shown in table 4.

Table 1 : Physical and chemical factors for all study sites

Standard Limited	Sit- 4	Site-3	Site-2	Site-1	Parameter
< 35	12.2-29 22.083c ±5.615	12-28 21.541b ±5.536	11.5 -28.5 20.916a ±5.418	11-28 20.541a ± 5.466	Water temp. ˚C
> 5	3.9 – 7.8 5.391 c ± 1.484±	3.9 – 8.2 5.666 b ± 1.464	3.7 – 7.6 6.008a±1.596	4.8 – 8.8 6.516 a ± 1.409	D. O mg/l
< 5	1.2 – 3.2 2.308 a ± 0.622	1.2 – 3.1 2.308 a ± 0.633	1.2 – 3.3 2.33 a ±.623	1.1-2.9 2.25 a ± 0.596 a	BOD mg/l
6.5 – 8.5	7.1 – 7.5 7.366 a ± 0.231	7.1 – 7.8 7.329 a ± 0.230	6.95 – 8 7.362 a ± 0.350	6.8 – 8 7.383 a ± 0.340a	pH
500	980-1880 1404 b ± 342.48	1080-1820 1405.5 b ± 00.18	940-1820 1354.8 a ± 313.4a	900-1780 1307.9 a ± 308.8	TDS mg/l
200	391-732 542 b ± 82.476	386-708 512 c ± 78.543	324-672 482 a ± 62.342	340 – 680 496 a ± 68.321	Total Hardness mg/l
---	1.93-5.69 3.18 b ± 1.2	1.98-8.63 4.14 a ± 1.80	2.11-7.23 5.06 a ± 2.64	2.35-6.48 5.14 a ± 2.2	Chl.a mg/l
50	0.314-2.843 0.911 c ± 0.838	0.359-2.813 0.997 b ± 0.924	0.321-3.423 0.995 b ± 1.001	0.135-2.35 1.06 a ± 1.01	NO_3 mg/l
0.1	0.026-0.732 0.190 c ± 0.150	0.023-0.856 0.208 b ± 0.191	0.0162-0.834 0.287 b ± 0.263	0.018-0.729 0.177 a ± 0.122	NO_2 mg/l
0.2	0.018-1.213 a 0.257 ± 0.360	0.019-1.346 a 0.239 ± 0.394	0.021-1.425 a 0 .287 ± 0.413	0.012-1.321 0.258 a ± 0.381	PO$ mg/l

Similar letters mean no significant differences, while different letters mean significant differences at a probability level P > 0.05.

Table 3 : Heavy metals for all study sites

Standard Limited	Sit -4	Sit -3	Site -2	Site – 1	Heavy metals Mg/l
0.05	0.0052-0.22 c 0.13	0.0038-0.178 a 0.123	0.0045-0.18 b 0.11	0.006-0.21 a 0.12	Lead
0.01	0.0042-0.13 0.046	0.0041-0.094 0.038	0.0024-0.076 0.037	0.003-0.087 0.032	Cadmium
0.1	0.048-0.137 b 0.078	0.063-0.129 c 0.092	0.032-0.143 b 0.085	0.02-014 a 0.06	Chromium
2	0.0018-0.074 0.048 c	0.0013-0.053 b 0.031	0.0021-0.063 b 0.032	0.0012-0.045 0.023 a	Copper

Similar letters mean no significant differences, while different letters mean significant differences at a probability level P > 0.05.

Table 4: Bacteriological factors for all study sites

Sit -4	Sit -3	Sit -2	Site – 1	Parameters
167456-311456 254667 c± 245678	134567-275678 241366 b ± 367967	151567-286789 246789a ± 386543	14956-27386 234567a±39356	Total Coli forms –TC (cell/100 ml)
138234-248567 211546 d ± 29456	121897-270234 214678 c ± 32765	126789-253456 208456 b ± 33678	130456-26766 213456 a ± 314234	*E.coli* (CFU/100 ml)
121456-215876 166734 b ± 28675	117345-198345 159456 c ± 25347	110456-203786 168345 b ± 27345	98345-190346 160567 a ± 23768	Fecal coliform (Cell/100 ml)

Similar letters mean no significant differences, while different letters mean significant differences at a probability level P > 0.05.

Conclusion

The results of the current study and its comparison with the global standards of river water shows that the quality of the water of agricultural falcons exceeded in a number of factors studied global determinants so it is necessary to reduce the use or dilution of river water before using them to raise fish.

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