Effects of some antibiotic residues on some health parameters of two species of fish in Shatt Al-Arab, southern Iraq

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Abstract

The presence of antibiotics in the aquatic environment poses great concerns because of their impacts on water quality, aquatic organisms and human health. This study aimed to detect the residues of antibiotics including (Amoxicillin (AMO), Ciprofloxacin (CIP) and Levofloxacin (LEV)) seasonally in the muscles and liver of (*Planiliza abu*) and (*Oreochromis niloticus*) fish and indicating their effects on some health aspects of fish during November 2020 to August 2021 in two selected stations from Shatt Al-Arab, Basrah, Iraq. The samples were analysed using high performance liquid chromatography (HPLC). The study recorded high levels of antibiotics in the muscles and liver of fish, and the concentrations were higher in the second station than in the first one. In *P. abu* the antibiotic AMO occupied the highest concentration in the muscles and liver of fish in the second station during the spring exhibiting (8.7 and 6.2 mg kg^{-1}), respectively. The lowest values of CIP were recorded in fish muscles in the first station during the autumn, amounting to (2.8 mg kg^{-1}). The lowest values of LEV were recorded in fish livers in the first station during the autumn amounting to (1.3 mg kg^{-1}). While in *O. niloticus* fish the antibiotic CIP had the highest concentration (7.4 mg kg^{-1}) in muscles in the spring, and the AMO showed the highest concentration (4.1 mg kg^{-1}) in the liver during the spring. In this study, the accumulation of antibiotics in the liver and muscles of fish exhibited negative effects on the health standards. The presence of antibiotic residues in fish samples in these high concentrations is a source of great concern as it is a major source of human food. The study emphasized the need to conduct more studies to detect this type of pollution and know its negative effects on the health aspects of other types of fish.

Keywords: Pollution, Antibiotics, Fish, *Planiliza abu*, *Oreochromis niloticus* Haematological parameters.

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Introduction

Antibiotics are substances that reduce or prevent the reproduction and growth of microorganisms that infect humans, including bacteria (Cheng *et al.,* 2017; Torres *et al.,* 2017). The role of antibiotics is not limited to treating infectious diseases in humans, also in animals of all kinds (Thakare *et al.,* 2020), and some are used as growth stimulants in aquaculture activities (Chen *et al.,* 2018). It is considered necessary to maintain public health and the continuity of life, as the death rate at the beginning of the last century due to infectious diseases constituted over 50% of the total, while declined to 3% in 2000. This decline is attributed to several reasons, including the use of antibiotics. However, in recent years, they have been recognized as serious and active environmental pollutants due to their presence in everywhere in high concentrations in surface waters, ground waters, soils, sediments and animals in almost all parts of the world (Kovalakova *et al.,* 2020; Lu *et al.,* 2020). Pollution with antibiotics is attributed to many factors, including the release of antibiotics that are not absorbed by humans and animals into the water bodies. In addition, most of the remaining unused antibiotics from laboratories, pharmaceutical factories, residential and commercial areas, and hospitals are disposed of it the water systems (Qiao *et al*., 2018; Ngigi *et al*., 2020)

This study also showed that the antibiotic SUL led to the inhibition of growth in Nile tilapia fish, emphasizing the need for rational and regulated use of antibiotics in aquaculture. Han *et al.* (2021) studied the spatial distribution and risk assessment of 14 antibiotics in typical mariculture farms surrounding the Bohai Sea in China and antibiotics were detected in seawater, sediments, some marine fish, mollusks, and sea cucumbers. Li *et al.* (2021) detected 12 antibiotics were detected in the muscle tissue of cultured aquatic organisms and in water and sediments in eastern China. This study also showed that the potential risks from ingesting these aquatic organisms are few and limited, except for the antibiotics belonging to the group of fluoroquinolones. Bojarski and Witeska (2020) showed the presence Effect of antibiotic residues on some health parameters of Nile tilapia, revealing chronic exposure cause physiological disturbances such as hematological changes, oxidative stress, histopathological changes, weak immunity, metabolic disorders, and general stress. Also, this study showed that low concentrations of antibiotics can affect the reproductive process. Low concentrations of antibiotics can also affect aquatic bacterial communities, causing changes in the microorganisms that live symbiotically with fish. Kondera *et al.* (2020) studied the effect of adding Oxytetracycline and Gentamicin in the diets on the hematological parameters of juvenile *Cyprinus carpio*. Their results showed no significant hematological or hepatotoxicity of therapeutic doses of OTC and GEN on juveniles, and this study also confirmed no significant changes in the values of hematological and biochemical parameters after taking OTC and GEN antibiotics. Nibamureke *et al.* (2019) studied the effect of the antibiotic Nevirapine on the liver of *O. mossambicus* in African surface waters under controlled conditions for 30 days concluding that NVP causes histological changes to liver cells and causes fibrosis around some veins and bile ducts and confirmed that long-

term exposure to the antibiotic NVP causes negative effects on fish health. The current study aims to identify the effect of antibiotic residues accumulated in the liver and muscles of Nile tilapia on some health parameters collected from Shatt Al-Arab.

Materials And Methods

Description of the study area

One of the major rivers is the Shatt al-Arab, which originates at the Qurna City, north of Basrah, where the Tigris and Euphrates rivers converge. It then flows southeast for about 195 km, draining into the is Arabian Gulf south of Faw City. The river's breadth varies from 400 meters near Basrah to roughly 1500 meters next to Ras Al-Bishah. Thereafter it confluences with Karun River. Its depth ranges between 8 and 15 m, and the depths may reach higher in some areas (AL-Mahmood *et al.,* 2011). The southern part of Shatt Al-Arab River suffers from tidal phenomenon as a result of the entry of the Arabian Gulf waters to it. therfore, the quality of the downstream water becomes mixed between marine and fresh (Abdullah *et al.,* 2015).

In this study, two stations were selected at Shatt Al-Arab to detect antibiotics in water, sediments and fish (Fig. 1). The first station was located in the center of Basrah, beside Al-Sadr Teaching Hospital within latitude and longitude of 30° 30' 33" N and 47° 51' 03" E. It was located beside a dock for commercial ships, and the movements of recreational boats and fishing boats were active. The other aspects of this station were the presence of many tourist restaurants that throw their waste into the river, and also its proximity to Al-Sadr Teaching Hospital, where it is considered as a source of great pollution discharging to the river. The second station was located beside the Salhiya River, within latitude and longitude of 30° 30' 24" N and 47° 51' 27" E. The movement of recreational boats, transport and fishing boats was also active, and the area was influenced by the water coming from the Salhia River, which contributes to increasing the pollution of the area.

Figure 1. A map showing the two sampling stations.

Sample collection

Fish samples were collected from the two selected study stations seasonally over a full year, from November 2020 to August 2021.

Fish samples

Two fishing methods were used to collect fish samples, the first was Gill net Drift, which is 120 m long and the size of its holes is 15 × 15 mm, and the second was cast net which has a diameter of 9 m and the size of its holes is 15 × 15 mm. The caught fish were kept in a cork container containing crushed ice until transporting to the laboratory.

Detection of antibiotics

Preparation of standard solutions

Standard solutions were prepared at a concentration of 20 mg L-1 of amoxicillin (AMO) and 10 mg L-1 of ciprofloxacin (CIP) and levofloxacin (LEV) by dissolving the pure substances in D.D.W (Gros *et al.*, 2006; Hamscher *et al.*, 2002). Standard solutions were injected into the HPLC device in order to draw the standard curve, which is used to compare with the curve of the sample to estimate the amount of antibiotics it contains.

Solid-phase extraction (SPE)

In order to perform a quantitative analysis of each of the antibiotics (amoxicillin, ciprofloxacin, levofloxacin) in the sample, 10 g of the sample was taken and placed in a volumetric vial followed by adding a capacity of 250 mL and 100 mL (methanol: distilled water; 1:1) to it and mixing for one hour on a magnetic stirrer. Then it was placed in a sonic boom device for 30 min. Thereafter the sample was filtered through a 0.45 µm filter. The final volume was completed to 250 mL with distilled water. The sample was stored in the refrigerator for analysis by HPLC.

Analytical methods

Amoxicillin

The examination was conducted in the laboratories of the Ministry of Science and Technology, Department of Environment and Water, Baghdad, using a high-performance liquid chromatography device (HPLC; model SYKAMN; Germany) according to the instruction (P1500 pump, UV2000 detector, AS3000 automatic sampling device; Unutkan *et al.* (2018). We used the carrier phase consisting of acetonitrile: methanol: phosphite buffer according to the following ratios (10:30: 60; V / V / V). Then a separation column C18 - ODS (25 cm × 4.6 mm) was used followed by using an ultraviolet detector (UV - 230 nm) at a flow rate of 1 mL min-1.

Ciprofloxacin & Levofloxacin

The examination was conducted in the laboratories of the Ministry of Science and Technology, Department of Environment and Water, using a high-performance liquid chromatography device (HPLC; model SYKAMN; Germany) according to the instruction

(Naveed *et al.*, 2014). We used the carrier phase consisting of (methanol: distilled water) according to the following ratios (70: 30; V / V), and a separation column C18 - ODS (25 cm × 4.6 mm) using a radiation detector followed by ultraviolet (UV - 294 nm) at a flow rate of 1 mL min-1.

Hematological parameters

Blood samples were collected by drawing blood from the heart in a test tube containing 2.5% EDTA (Ethylenediaminetetra-acetic acid). The total protein of the blood plasma was measured by a ready-made laboratory kit (Randox, USA) using a spectrophotometer at a wavelength of 546 nm, according to the equation of total protein concentration (mg/ 100ml)

= (sample reading/standard reading) x 6.

The concentration of albumin in the blood plasma was measured by a ready-made kit (Randox, USA) using a spectrophotometer at a wavelength of 630 nm according to the equation of Albumin concentration (mg/ 100ml)

= (sample reading/standard reading) x 4.5.

Globulin concentration was measured by subtracting the albumin value from the total protein value for all samples (Wolf and Darlington, 1971) i.e. Globulin concentration (mg/ 100ml)

= Total protein concentration - Albumin concentration.

The Hemoglobin of the blood plasma was measured by a ready-made kit (Randox, USA) using a spectrophotometer at a wavelength of 570 nm, according to the equation of Hemoglobin concentration (mg/ 100ml)

= (sample reading - standard reading).

Statistical analysis

The statistical program Statistical Package for Social Science (SPSS) was used to conduct the statistical analysis under the significance level of 0.05.

Results

Antibiotics in fish

Antibiotics are considered dangerous environmental pollutants and spread in all sections of the aquatic environment at the present time. Two groups of antibiotics, fluoroquinolone (levofloxacin, amoxicillin) and B-lactam (ciprofloxacin) were detected in this study.

Antibiotics in fish muscles

Fig. 2 shows the seasonal and local alterations in the values of antibiotics (levofloxacin, amoxicillin and ciprofloxacin) in *P. abu* fish muscles during the study period. The lowest values, belonging to CIP were recorded during the autumn amounting to 2.8 mg kg-1 at the first station, while the highest belonging to AMO during the spring reaching 8.7 mg kg-1 at the second one.

The seasonal and local changes of the antibiotics (Levofloxacin, Amoxicillin, and Ciprofloxacin) in the muscles of Nile tilapia during the study period are shown in Fig. 3. The lowest values were recorded at the first station during autumn for LEV (1.3 mg/kg), and the highest value recorded at the second station during spring was the CIP (7.4 mg/kg).

Antibiotics in fish liver

Fig. 4 shows seasonal and local changes in the values of antibiotics (levofloxacin, amoxicillin and ciprofloxacin) in *P. abu* fish livers during the study period. The lowest values belonging to LEV were recorded during the Autumn season, reaching 1.3 mg kg^{-1} at the first station, while the highest belonging to AMO in the spring, reaching 6.2 mg kg^{-1} at the second one. Fig. 5 shows the seasonal and local changes in the values of antibiotics (Levofloxacin, Amoxicillin, and Ciprofloxacin,) in the liver of Nile tilapia during the study period. The lowest values were recorded at the first station during summer for CIP (0.38 mg/kg), and the highest values in the second station during spring for AMO (4.1 mg/kg).

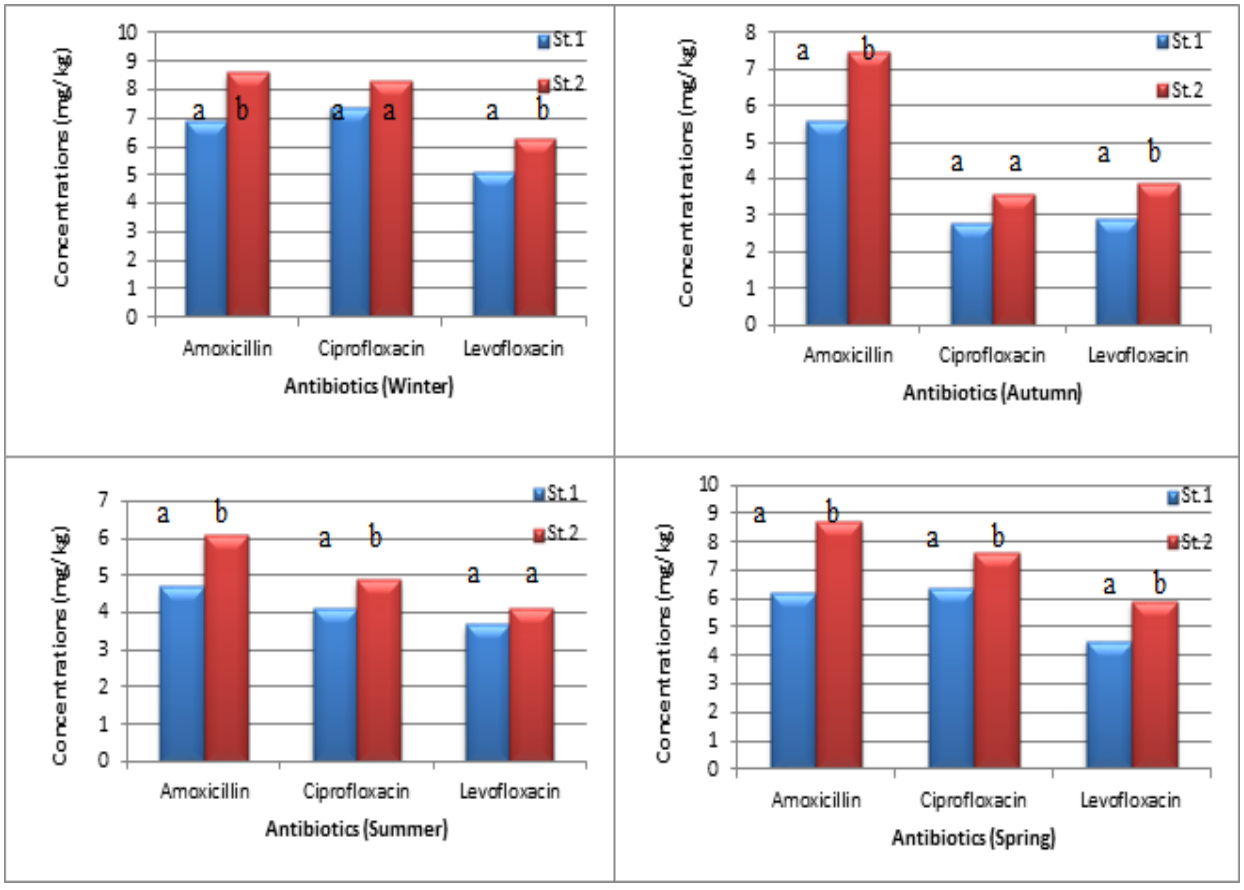

Figure 2. Seasonal and local changes in the values of antibiotics (Levofloxacin, Amoxicillin, Ciprofloxacin,) in muscles of *P. abu* fish during the study period, (different letters in the stations are significantly different (P<0.05).

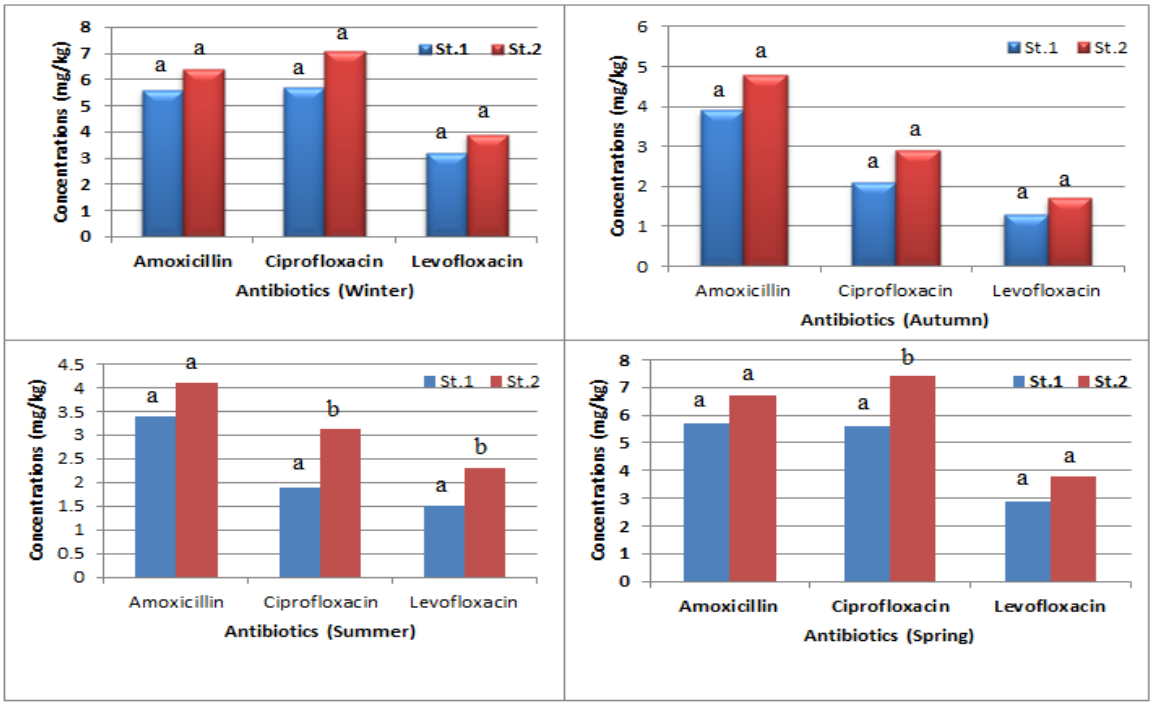

Figure 3. Seasonal and local changes in the values of antibiotics (Levofloxacin, Amoxicillin and Ciprofloxacin) in the muscles of Nile tilapia fish during the study period, (different letters in the stations are significantly different (P<0.05).

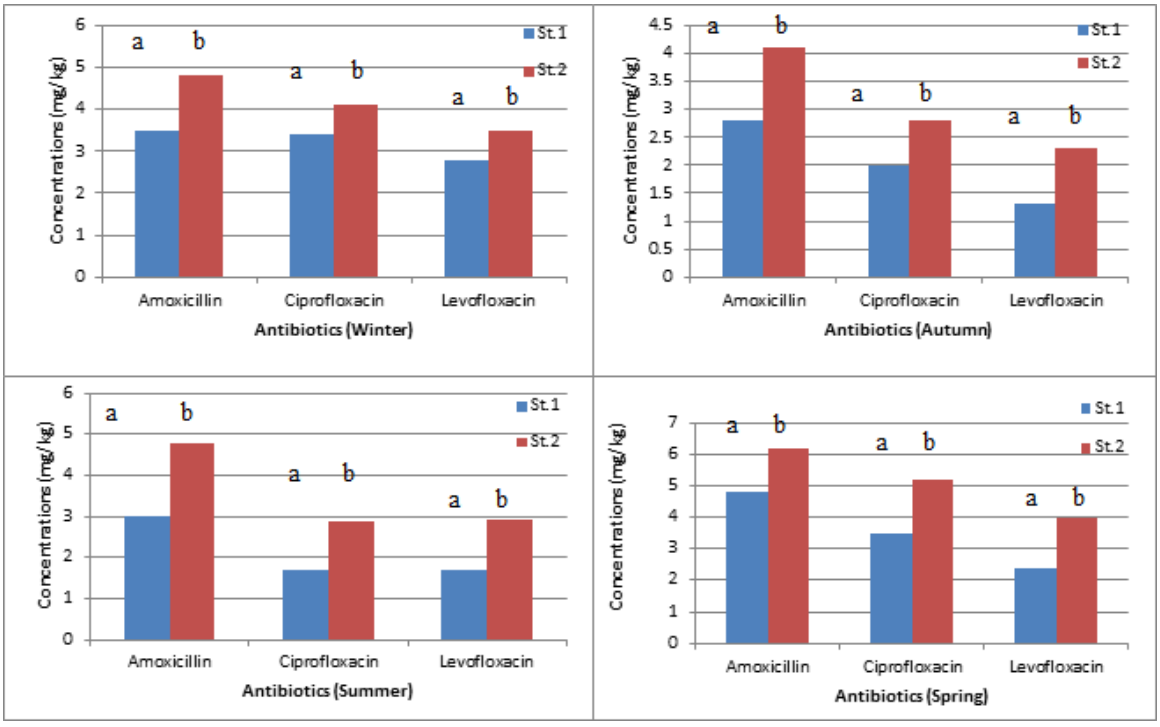

Figure 4. Seasonal and local changes in the values of antibiotics (Levofloxacin, Amoxicillin, Ciprofloxacin,) in livers of *P. abu* fish during the study period, (different letters in the stations are significantly different (P<0.05).

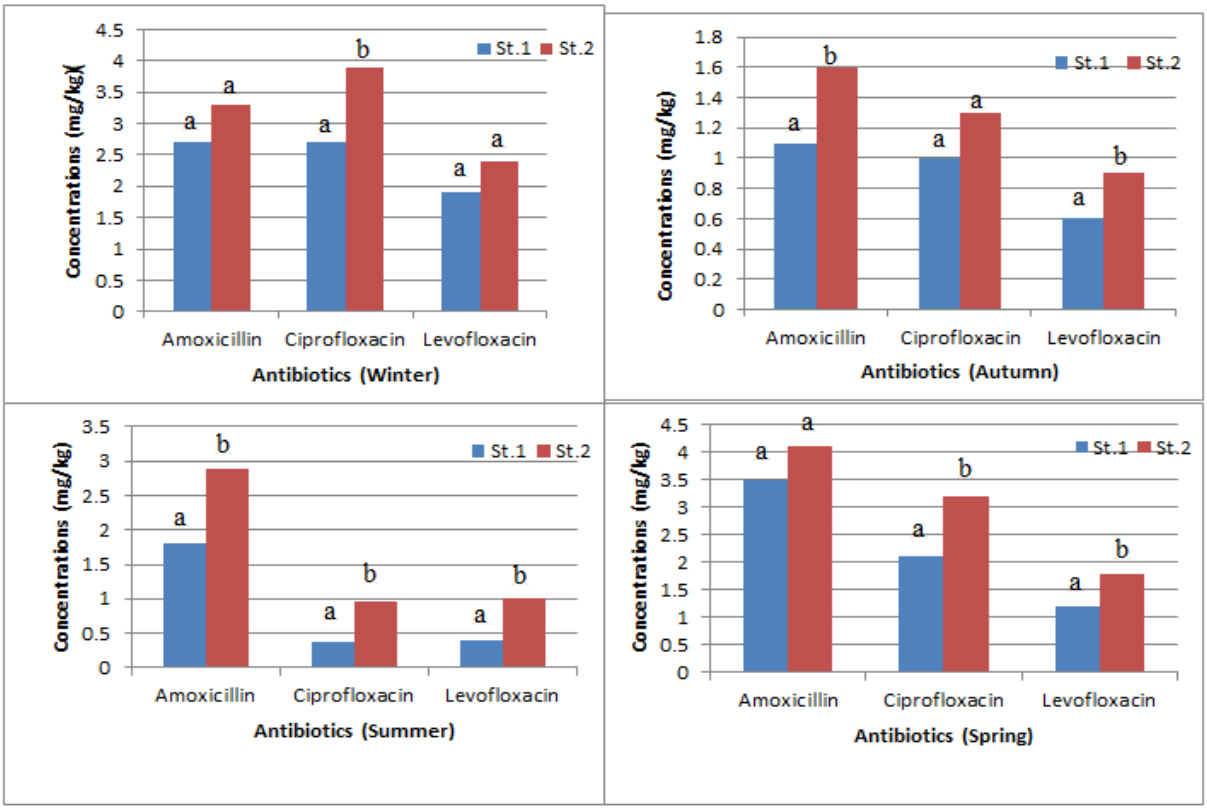

Figure 5. Seasonal and local changes in the values of antibiotics (Levofloxacin, Amoxicillin, Ciprofloxacin) in livers of Nile tilapia fish during the study period, (different letters in the stations are significantly different (P<0.05).

Haematological parameters

Enzymatic tests of blood plasma

Tables 1,2 show the seasonal and local changes in the total protein, albumin, globulin, and hemoglobin in fish during the study period. The lowest values of total protein were recorded in the blood plasma of *P. abu* during the winter season (2.173 mg/100ml) and the highest values were recorded in the blood plasma of *O. niloticus* during the autumn season (3.566 mg/100ml).

While the lowest albumin values were recorded in the blood plasma of *P. abu* during the summer season (1.073 mg/100ml), and the highest values were recorded in the blood plasma of *O. niloticus* during the autumn season (1.52 mg/100ml). As for globulin, the lowest and highest values were recorded in the blood plasma of *P. abu* during spring and winter respectively **(**1.126 mg/100ml and1.736 mg/100ml). As for hemoglobin, the lowest values were recorded in the blood plasma of the *P. abu*during the spring season (24.333%) and the highest in the blood plasma of the *O. niloticus* during the winter season (41.833%).

Table 1. Concentrations of total protein, Albumin, Globulin and hemoglobin in the blood plasma of *O. niloticus* and *P. abu* fish in the first station.

Seasons (mean ± standard deviation)					
Hematological parameters	**fish**	**Autumn**	**Winter**	**Spring**	**Summer**
		St1	**St2**	**St1**	**St2**
Total protein (mg/ 100 ml)	***O. niloticus***	3.88 ± 0.144 a	3.233 ± 0.236 b	3.166 ± 0.208 b	3.39 ± 0.441 c
	P. abu	3.17 ± 0.285 a	2.623 ± 0.251 b	2.6 ± 0.360 b	3.133 ± 0.152 a
Albumin (mg/ 100 ml)	***O. niloticus***	2.593 ± 0.061 a	2.286 ± 0.155 b	2.14 ± 0.069 c	1.656 ± 0.228 d
	P. abu	1.57 ± 0.065 a	1.323 ± 0.105 b	1.306 ± 0.083 b	1.133 ± 0.011 b
Globulin (mg/ 100 ml)	***O. niloticus***	1.28 ± 0.105 a	0.953 ± 0.055 a	1.26 ± 0.208 ba	1.166 ± 0.060 b
	P. abu	1.343 ± 0.137 a	1.16 ± 0.045 b	1.256 ± 0.136 a	1.16 ± 0.043 b
Hemoglobin (%)	***O. niloticus***	42.833 ± 1.755 a	53.1 ± 2.007 b	41.333 ± 2.516 a	38.733 ± 0.461 c
	P. abu	40.666 ± 3.785 a	48 ± 2.645 b	34.333 ± 2.081 c	37.206 ± 1.203 c

Table 2. Concentrations of total protein, albumin, globulin and hemoglobin in the blood plasma of *O. niloticus* and *P. abu* in the second station.

Hematological parameters	Seasons (mean ± standard deviation)				
	fish	Autumn	Winter	Spring	Summer
		St1	St2	St1	St2
Total protein (mg/ 100 ml)	*O. niloticus*	3.566 ± 0.351 a	2.57 ± 0.320 b	2.333 ± 0.251 c	3.1 ± 0.173 b
	P. abu	2.53 ± 0.340 a	2.173 ± 0.205 b	2.2 ± 0.264 b	2.366 ± 0.205 b
Albumin (mg/ 100 ml)	*O. niloticus*	1.52 ± 0.096 a	1.32 ± 0.108 b	1.213 ± 0.085 b	1.13 ± 0.017 b
	P. abu	1.33 ± 0.026 a	1.143 ± 0.025 b	1.106 ± 0.011 b	1.073 ± 0.063 b
Globulin (mg/ 100 ml)	*O. niloticus*	1.366 ± 0.309 a	1.49 ± 0.351 a	1.143 ± 0.005 b	1.153 ± 0.049 b
	P. abu	1.66 ± 0.285 a	1.736 ± 0.382 a	1.126 ± 0.015 b	1.153 ± 0.015 b
Hemoglobin (%)	*O. niloticus*	38.566 ± 1.115 a	41.833 ± 3.329 b	28.833 ± 1.040 c	35.47 ± 2.200 a
	P. abu	35.533 ± 3.312 a	39.9 ± 1.571 a	24.333 ± 3.214 b	33.503 ± 2.605 a

Discussion

Antibiotics in fish

Fish were employed as bio-indicators to assess the degree of an organism's resistance to contamination and its responses to environmental factors. practical instrument for environmental monitoring. Since antibiotics were found seasonally in fish's muscles and liver over the seasons of a year, this study is the first to evaluate antibiotic concentrations in fish. The current study's findings demonstrated a wide range of antibiotic levels in fish muscles and liver, from high to low. The findings also demonstrated that the majority of the antibiotic concentrations found in the current investigation are extremely high and regarded as high risk. In addition, it can have direct health risks to humans in different age groups, especially Ciprofloxacin (CIP), since its low concentration is considered toxic to children from one to three months of age (Cui *et al.,* 2018).

Hu *et al.* (2010) and Kemper (2008) reported that the presence of antibiotics in the aquatic environment, even at very low concentrations, leads to chronic and hidden effects, such as the effects on fish behaviour and the feminization of males of some fish species. The concentrations of antibiotics were higher at the second station than at the first one, , which might be because it is close to the Salhia River, which is sewage-polluted. Antibiotic concentrations were also higher in the muscles of *P. abu* than in the Nile tilapia fish, which may be due to the nature of the feeding of these fish and their ability to accumulate pollutants. The results of the study also showed that the accumulation of antibiotics was higher in the fish muscles than in the liver, which may indicate the persistence of this type of pollution inside the fish body, reflecting that the muscles are the last part in which the absorption or accumulation of pollutants occurs, since muscles are inactive tissues (Ben Salem *et al.,* 2014; Abbaszadeh and Şişman, 2021; Jorfipour *et al.,* 2022).

The highest values of AMO were recorded in the liver of *P. abu*, as well as high values in the muscles which may be due to its high ability to accumulate and its high presence in the environment as a result of its very wide use in the treatment of humans and animals. It is a broad-spectrum antibiotic used to treat many infections, caused by many types of bacteria (Bielen *et al.,* 2017). In the case of LEV, it was recorded in low concentrations in the fish liver and muscles which may be due to its rapid chemical breakdown. The highest values of AMO antibiotic were recorded in the liver of Nile tilapia and rough tilapia, as well as high values in fish muscles. This is probably due to its high ability to accumulate and its high presence in the environment as a result of its very wide use in treating humans and animals. It is a broad-spectrum antibiotic used to treat many infections caused by many types of bacteria (Bielen *et al.*, 2017). As for the antibiotic LEV, it was recorded at low concentrations in the liver and muscles of fish, and this is probably due to its rapid chemical degradation (Manage, 2018).

Haematological parameters

Enzymatic tests of blood plasma

Blood parameters are important indicators in determining the health status of living organisms, including fish (Gharaei *et al.,* 2016). There are important indicators that can express the internal state of the body to exhibit a picture of the positive or negative physiological and immune responses in fish (Akbary and Jahanbakhshi 2017). Data on the haematological and immune response in fish after exposure to antibiotics are scarce and ambiguous, since they depend on the antibiotic dose and the sensitivity of different fish species. Changes in biochemical parameters (Total protein, Albumin, and Globulin) can be attributed to changes in the liver. The highest values of total protein and albumin were recorded in the first station in tilapia fish and the lowest in the second station in *P. abu*. The increase in the level of proteins in blood plasma in the current study may indicate an increase in their production in the body and a decrease in the demolition process. The reason for the decrease in the level of both total protein and albumin in the blood plasma of fish may be due to damage to the blood vessels resulting from exposure to pollutants, and the exit of blood cells from the bloodstream to the tissues, causing hypoproteinemia (Bly *et al*., 1994).

Kitancharoen and Hatai (1996) also mentioned that the low level of albumin in the blood plasma is due to the low efficiency of the liver in the formation of this protein and that its decrease is another reason for the decrease in the percentage of total protein because albumin constitutes 80% of it i.e. globulin-type proteins increase. In the current results the level of globulin increased in the *P. abu* in the second station and decreased in the Nile tilapia fish in the first station.

Hemoglobin is a crucial part of red blood cells and is involved in the oxygen transport process in fish blood in general. Due to a shift in the permeability of the cell membrane and a rise in mechanical fragility, poor red blood cell production affects the kidney and spleen, which destroy red blood cells and lower hemoglobin levels in fish blood plasma (Kondera *et al*., 2020). The results of the current study showed a variation in hemoglobin concentrations, and high concentrations of hemoglobin were recorded in tilapia fish during the winter. This may be due to the low concentrations of oxygen in the tissues as a result of exposure to pollution, and thus there is a need to produce red blood cells (Serezli *et al*., 2005). In addition, this increase may be due to the efficiency of the hormone Thyroxine, which is one of the hormones that regulate metabolism that this hormone causes an increase in metabolic reactions in tissues, which leads to an increase in the need for oxygen increasing hemoglobin (Thanikachalam *et al*., 2010). While the study recorded a decrease in the concentration of hemoglobin in the blood plasma of the *P. abu* during the spring season in the two study stations, this is consistent with the study by Omoregie and Oyebanji (2002) in which a significant decrease in the concentration of hemoglobin was observed as a result of fish being exposed to feeds containing antibiotics at a rate of 0.6-5% without a prescription for a period of 8 days.

References:

Abdullah, A.D.; Masih, I.; van der Zaag, P.; Karim, U.F.A.; Popescu, I., and Al Suhail, Q. (2015). Shatt al Arab River system under escalating pressure: a preliminary exploration of the issues and options for mitigation. International J. River Basin Manage., 13(2): 215-227.

Al-Mahmood, H.K.H.; Al-Sayaab, H.A.; Al-Miahi, D.S.B.; Mahmoud, A.B.and Mutasher, W.R. (2011). One dimensional model to study hydrodynamics properties for north part of Shatt Al Arab River (south Iraq). Basrah J. Sci., 28(1): 1-14.

Ben Salem, Z.; Capelli, N.; Laffray, X.; Elise, G.; Ayadi, H., and Aleya, L. (2014). Seasonal variation of heavy metals in water, sediment and roach tissues in a landfill draining system pond (Etueffont, France). Ecol. Eng., 69: 25-37.

Bielen, A.; Simatovic, A.; Kosic-Vuksic, J.; Senta, I.; Ahel, M.; Babic, S., and Udikovic-Kolic, N. (2017). Negative environmental impacts of antibiotic-contaminated effluents from pharmaceutical industries. Water Res., 126: 79-87.

Bly, J.E.; Lawson, L.A.; Abdel-Aziz, E.S., and Clem, L.W. (1994). Channel catfish, *Ictalurus punctatus*, and immunity to *Saprolegnia* sp. J. App. Aquac., 3(1-2): 35-50.

Bojarski, B., and Witeska, M. (2020). Blood biomarkers of herbicide, insecticide, and fungicide toxicity to fish-A review. Environ. Sci. Pollut. Res., 27: 19236-19250.

Kemper, N. (2008). Veterinary antibiotics in the aquatic and terrestrial environment. Ecol. Indicators, 8(1): 1-13.

Kitancharoen, N., and Hatai, K. (1996). Experimental infection of Saprolgnia spp. in rainbow trout egg. Fish Pathol., 31(1): 49-50.

Gros, M.; Petrovi, M.C., and Barcel, D.O. (2006). Development of amultiresidue analytical methodology based on liquid chromatography–tandem mass spectrometry (LC–MS/MS) for screening and trace level determination of pharmaceuticals in surface and waste waters. Talanta, 70(4): 678-690.

Kovalakova, P.; Cizmas, L.; McDonald, T.J.; Marsalek, B.; Feng, M. and Sharma, V.K. (2020). Occurrence and toxicity of antibiotics in the aquatic environment: A review. Chemosphere, 251: 126351.

Kovalakova, P.; Cizmas, L.; McDonald, T.J.; Marsalek, B.; Feng, M. and Sharma, V.K. (2020). Occurrence and toxicity of antibiotics in the aquatic environment: A review. Chemosphere, 251: 126351.

Chen, H.; Liu, S.; Xu, X.R.; Diao, Z.H.; Sun, K.F., and Hao, Q.W. (2018a). Tissue distribution, bioaccumulation characteristics and health risk of antibiotics in cultured fish from a typical aquaculture area. J. Hazard. Mater. 343: 140–148. https://doi:10.1016/j.jhazmat.2017.09.017

Cheng, D.; Liu, X.; Zhao, S.; Cui, B.; Bai, J., and Li, Z. (2017). Influence of the natural colloids on the multi-phase distributions of antibiotics in the surface water from the largest lake in North China. Sci. Total Environ., 578: 649–659. https://doi:10.1016/j.scitotenv.2016.11.012

Torres, N.H.; de Salles Pupo, M.M.; Ferreira, L.F.R.; Maranho, L.A.; Americo- Pinheiro, J.H.P.; Vilca, F.Z., and Tornisielo, V.L. (2017). Spatial and seasonal analysis of antimicrobials and toxicity tests with *Daphnia magna*, on the sub-basin of Piracicaba river, SP, Brazil. J. Environ. Eng., 5(6): 428 6070-6076. https://doi.org/10.1016/j.jece.2017.11.031

Nibamureke, U.; Barnhoorn, I., and Wagenaar, G. (2019). Nevirapine in African surface waters induces liver histopathology in *Oreochromis mossambicus*: A laboratory exposure study. Afr. J. Aquat. Sci., 44(1): 77–88. https://doi:10.2989/16085914.2019.1571477

Gharaei, A.; Rayeni, M.F.; Ghaffari, M.; Akrami, R., and Ahmadifar, E. (2016). Influence of dietary prebiotic mixture (α-mune) on growth performance, haematology and innate immunity of beluga sturgeon (*Huso huso*) juvenile. Int. J. Aquat. Biol., 4(4): 277-284.

Manage, P.M. (2018). Heavy use of antibiotics in aquaculture: Emerging human and animal health problems—A review. (Sri Lanka) J. Aquat. Sci., 23(1): 13–27. http://doi.org/10.4038/sljas.v23i1.7543

Kondera, E.; Bojarski, B.; Ługowska, K.; Kot, B., and Witeska, M. (2020). Effects of Oxytetracycline and gentamicin therapeutic doses on Hematological, biochemical and hematopoietic parameters in *Cyprinus carpio* Juveniles. Animals, 10(12): 2278.

Li, J.Y.; Wen, J.; Chen, Y.; Wang, Q., and Yin, J. (2021). Antibiotics in cultured freshwater products in Eastern China: Occurrence, human health risks, sources, and bioaccumulation potential. Chemosphere, 264: 128441.

Lu, S.; Lin, C.; Lei, K.; Wang, B.; Xin, M.; Gu, X.; Cao, Y.; Liu, X.; Ouyang, W., and He, M. (2020). Occurrence, spatiotemporal variation, and ecological risk of antibiotics in the water of the semi-enclosed urbanized Jiaozhou Bay in eastern China. Water Res., 184: 116187.

Naveed, S.; Sultana, N.; Arayne, M.S., and Dilshad H.D. (2014). A new HPLC method for the assay of levofloxacin and its application in drug-metal interaction studies. J. Sci. Innovative Res., 3(1): 91-96.

Ngigi, A.N.; Magu, M.M., and Muendo, B.M. (2019). Occurrence of antibiotics residues in hospital wastewater, wastewater treatment plant, and in surface water in Nairobicounty, Kenya. Environ. Monit. Assess., 192(1): 18.

Cui, C.; Han, Q.; Jiang, L.; Ma, L.; Jin, L.; Zhang, D., and Zhang, T. (2018). Occurrence, distribution, and seasonal variation of antibiotics in an artificial water source reservoir in the Yangtze River delta, East China. Environ. Sci. Pollut. Res., 25(20): 19393-19402.

Hamscher, G.; Sczesny, S.; Hoper, H., and Nau, H. (2002). Determination of persistent tetracycline residues in soil fertilized with liquid manure by high-performance liquid chromatography with electrospray ionization tandem mass spectrometry. Anal. Chem., 74(7): 1509-1518.

Han, Q.F.; Zhang, X.R.; Xu, X.Y.; Wang, X.L.; Yuan, X.Z.; Ding, Z.J., and Wang S.G. (2021). Antibiotics in marine aquaculture farms surrounding Laizhou Bay, Bohai Sea: Distribution characteristics considering various culture modes and organism species. Sci. Total Environ., 760: 143863.

Hu, X.; Zhou, Q., and Luo, Y. (2010). Occurrence and source analysis of typical veterinary antibiotics in manure, soil, vegetables and groundwater from organic vegetable bases, northern China. Environ. Pollut., 158(9): 2992-2998.

Qiao, M.; Ying, G.G.; Singer, A.C., and Zhu Y.G. (2018). Review of antibiotic resistance in China and its environment. Environ. Int., 110: 160-172.

Serezli, R.; Cagirgan, H.; Okumus, I.; Akhan, S., and Balta, F. (2005). The effect of oxytetracycline on non-specific immune response in sea bream (*Sparus aurata* L. 1758). Turkish J. Veterinary Anim. Sci., 29(1): 31-35.

Thanikachalam, K.; Kasi, M. and Rathinam, X. (2010). Effect of garlic peel on growth, hematological parameters and disease resistance against *Aeromonas hydrophila* in African catfish *Clarias gariepinus* (Bloch) fingerlings. Asian Pac. J. Trop. Med., 3(8): 614-618.

Unutkan, T.; Bakırdere, S., and Key, F S. (2018). Development of an analytical method for the determination of amoxicillin in commercial drugs and wastewater Samples, and assessing its stability in simulated gastric digestion. J. Chromatogr. Sci., 56(1): 36-40.

Wolf, K., and Darlington, R.W. (1971). Channel catfish virus: a new herpes virus of ictalurid fish. J. Virol., 8(4): 525- 533.

تأثير بعض بقايا المضادات الحيوية على بعض المعايير الصحية لنوعين من الأسماك في شط العرب، جنوب العراق

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المستخلص

يُثير وجود المضادات الحيوية في البيئة المائية قلقًا بالغاً نظراً لتأثيراتها على جودة المياه والكائنات المائية وصحة الإنسان. هدفت هذه الدراسة إلى الكشف عن بقايا المضادات الحيوية، بما في ذلك الأموكسيسيلين (AMO) والسيبروفلوكساسين (CIP) والليفوفلوكساسين (LEV) موسمياً في عضلات وكبد أسماك (*Planiliza abu*) و(*Oreochromis niloticus*)، وبيان آثارها على بعض الجوانب الصحية للأسماك خلال الفترة من نوفمبر 2020 إلى أغسطس 2021 في محطتين مختارتين من شط العرب، البصرة، العراق. حُللت العينات باستخدام كروماتوغرافيا السائل عالي الأداء (HPLC). تُعد هذه الدراسة الأولى من نوعها في العراق التي تُشير إلى وجود بقايا مضادات حيوية في الأسماك. وقد سجلت الدراسة مستويات عالية من المضادات الحيوية في عضلات وكبد الأسماك، وكانت تراكيزها أعلى في المحطة الثانية منها في الأولى. في *P. abu* احتل المضاد الحيوي AMO أعلى تركيز في عضلات وكبد الأسماك في المحطة الثانية خلال فصل الربيع حيث أظهر (8.7 و 6.2 ملغم/ كغم) على التوالي. تم تسجيل أدنى قيم لـ CIP في عضلات الأسماك في المحطة الأولى خلال فصل الخريف، وبلغت (2.8 ملغم/ كغم). تم تسجيل أدنى قيم لـ LEV في أكباد الأسماك في المحطة الأولى خلال فصل الخريف وبلغت (1.3 ملغم/ كغم). بينما في أسماك *O. niloticus* كان للمضاد الحيوي CIP أعلى تركيز (7.4 ملغم/كغم) في العضلات في فصل الربيع، وأظهر AMO أعلى تركيز (4.1 ملغم/كغم) في الكبد خلال فصل الربيع. في هذه الدراسة، أظهر تراكم المضادات الحيوية في كبد وعضلات الأسماك آثارًا سلبية على المعايير الصحية. إن وجود بقايا المضادات الحيوية في عينات الأسماك بهذه التركيزات العالية هو مصدر قلق كبير لأنها مصدر رئيسي للغذاء البشري. وأكدت الدراسة على ضرورة إجراء المزيد من الدراسات لرصد هذا النوع من التلوث ومعرفة آثاره السلبية على الجوانب الصحية لأنواع أخرى من الأسماك.

الكلمات المفتاحية: التلوث، المضادات الحيوية، الأسماك، *Planiliza abu*، *Oreochromis niloticus*، المعايير الدموية.