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RESEARCH ARTICLE

HEMATOLOGICAL ANALYSIS OF SOME FISH SPECIES FROM THE AFFECTED EFFLUENT SITE OF THE WHITE NILE RIVER AT SOUTH OF KHARTOUM CITY, SUDAN

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ABSTRACT

Hematology analysis is a swift test of blood to help monitoring health condition of fish in natural fisheries of suspected polluted rivers. To evaluate health status of fish in the White Nile River at southern Khartoum City, a total of 120 different fish species were collected from both the targeted upstream polluted area and from the non-polluted upstream area. According to routine clinical methods, the hematological parameters of PCV, Hb, WBC, RBC, MCV, MCH and MCHC were investigated. All of these parameters were found to be insignificant different ($p > 0.05$) comparing with control, with exception of PCV%, which found to be significantly different ($p < 0.05$) comparing with control in all types of fish species, as well, MCV level was found to be significantly different in *Oreochromis niloticus* fish species, whereas MCH was significantly different in *Bagrus bayad* and the MCHC test was found to be significantly different in *Clarias lazera* fish species. It could be concluded that, in spite of being insignificantly different comparing to control, most of these hematological analysis found to be not compliance to the suggested hematology level of healthy fish.

INTRODUCTION

Industrial sewage of Military factory and the effluent discharge into the White Nile River at southern Khartoum City poses a potential hazard to aquatic life and the surrounding environment. During last decades, the extensive migration from rural areas to Khartoum City has becoming invisible creeping threat towards human resources. Pollution of water bodies affects the physicochemical characteristics of the water, sediments and biological components, thus negatively affecting the quality and quantity of fish stocks Zeitoun and Mehana (2014). Environmental pollution can cause poisoning, diseases and even death for fish. The absorption of heavy metal elements of various biological tissues on pollutants is an important biomedical problem (Wan *et al*., 2013). Changes in hematology of fish in response to other stressing agents are indicators of the stressful stage of fish, producing useful information to curb any unfavorable condition that may affect the fish health (Bello-Olusoji *et al*., 2006). It has been stated that blood is a potential index of fish health, as it can be used to ascertain the effect of pathogen challenge, quality of the diet and nutritional state of the fish, and/or the effect of pollutants in the environment (Adeyemo *et al*., 2014).

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Occurrence of metal contaminants especially the heavy metals in excess of natural loads into water body has become a problem of increasing concern in aquatic ecosystems. This situation has arisen as a result of many factors, e.g., the rapid growth of population, industrial development and discharge of untreated industrial wastes, increased urbanization, and expansion of natural resources, extension of irrigation and other modern agricultural practices as well as the lack of environmental regulations (Lester *et al*., 1983; Bagatto and Ali Khan, 1987). It is a worldwide problem and has created serious health concerns (Galindo *et al*., 1986; Pastor *et al*., 1988). The results of many field studies of metal accumulation in fish living in polluted waters show that considerable amount of various metals may deposited in fish tissues without causing mortality. Various metals are accumulated in fish body in different amounts. These differences result from different affinity of metals to fish tissues, different uptake deposition and excretion. Generally, the higher metal concentration in the environment, the more it may be taken up and accumulated by fish (Zeitoun and Mehana, 2014). As a result, the accumulation of heavy metals in fish tissues can lead to accumulation of these heavy metals in human tissues across the food chain. Therefore, this study was conducted to investigate the effect of heavy metals on health status of the fish species, commonly consumed in Khartoum City, through hematological routine chemical analysis.

MATERIALS AND METHODS

Collection of fish samples: Four types of fish species (Figure 1, 2, 3 and 4) were collected to study the hematological analysis changes due to polluted discharge water. Fishing started from August 2015 to October 2015. A total of 120 different fish species were collected, of which, a 60 tested fish were collected from the targeted polluted area; the first 30 fish of them were collected from the discharge zone of the White Nile River site (1), whereas the second 30 fish were collected from the main ponds of sewage site (2). The rest (120 fish) were collected from the upstream non-polluted area of Jebel Awlia Dam (site 3), as control (Figure 5). The collected different fish species were well washed with clean water and kept in polyethylene packages containing ice, then transported to the Central Veterinary Research Laboratory of the Omdurman University bending identification and analysis.

Figure 1. *Fish Clarias lazera* fish species, popular known as Garmout

Figure 2. Synodontis *schall* fish species, popular known as Gargor

Figure 3. *Oreochromis niloticus* fish species, popular known as Bulti

Figure 4. *Bagrus bayad* fish species, popular known as Bayad

Figure 5. Fish sampling points Sites(1,2 and 3).Site(1) at river Nile, Site (2) at Suba Sewage plant (test samples) .Site(3) Jebel Awlia Fesheries (control samples) Modified from www.Googleearth.com, (2016)

Collection and preservation of fish blood sample: Blood samples were collected from the freshly killing fish on spot in 5 ml sterilized syringes by direct caudal venous puncture and teal Ablation (CDFO, 2004). Blood samples were collected with sterilized plastic tubes having ethylene diamine tetra acetic acid (EDTA) to prevent blood clotting. Blood samples were then shifted to icebox and transported to the Central Veterinary Research Laboratory of the Omdurman University and then stored in refrigerator at 4°C for studying the hematological parameters (Ali, *et al* 2004).

Processing of blood for biochemical analyses

Processing of Blood: Blood samples were stored in glass tubes containing anticoagulant (EDTA) and stored in cooled bags, the blood analyses were carried out immediately after sampling. The blood was centrifuged at 3000 g, at 4°C for fifteen minutes to get clear plasma for biochemical analyses (Ali, 2004).

Hematological analysis of blood fish: Anti-coagulant (EDTA) preserved blood was used for the estimation of various hematological parameters like hemoglobin (Hb), packed cell volume (PCV), and red blood cell count (RBC). Estimation of hemoglobin content has been done according to Van-Kampan and Zijlstra (1961), packed cell volume according to micro-hematocrit method of Strumia *et al*. (1954), RBC count was determined according to routine clinical method. These values has been utilized for calculating mean corpuscular hemoglobin (MCH), mean corpuscular volume (MCV), mean corpuscular hemoglobin concentration (MCHC) according Dacie and Lewis (1977) as described below:

Hemoglobin = $\frac{\text{Volume obtained}}{100} \times 17.2$ mg/100mL

RBC = No of cells counted × 3 × 25 × 200 (10^6 mm^3)
WBC = No of cells counted × 0 × 25 × 10 × 20 (10^4 mm^3)

MCV (fl) = $\frac{\text{packed cell volume/dl} \times 10}{\text{RBC/µB } (10^n)}$ n=6

MCH (pg) = $\frac{\text{packed cell volume/dl} \times 10}{\text{RBC/µL } (10^n)}$ n=6

MCHC (g/dl) = $\frac{\text{Hb//dl} \times 10}{\text{PCV/ (\%)}}$

Statistical analysis: Student t-test analysis of variance, mean differences, correlation and chart were done by using SPSS (Statistical Package for Social Sciences) program version 22.

RESULTS

Hematological parameters of fish species

Hematological parameters of *Synodontis schall* fish species (commonly known as gargor)

Hematological parameters of *Synodontis schall* fish species were summarized in table 1, with regard to PCV test, PVC in blood sample of *Synodontis schall* fish in control (site 3) was found to be significantly higher (35.6%) than that of the contaminated water site 1 (32.1%). With respect to Hb in blood sample of *Synodontis schall* fish, no significant differences were found between fish of control water and fish of contaminated water of the White Nile River.

However, slight decrease was observed of Hb in blood sample of *Synodontis schall* fish of the contaminated river water (site 1) where the level was found to be 14.3 g/dl comparing to that of the control sample (site 3) where the level was 13.6 g/dl. According to the research, the level of WBC in blood sample of *Synodontis schall* fish of the contaminated water (site 1) was 6.9 ×10³cells/µl, this level was almost found to be equal to that of the control (site 3) where the level was 7×10³cells/µl. Regarding RBC×10^6 cells/µl, as shown in table 1, the tested sample of *Synodontis schall* fish species caught from the contaminated site 1(6.8 10^6 cells/µl) found to be above (but not significant different) that of the control sample that amounted to 6.7×10^6 cells/µl. As shown in table 1, the level of MCVfl regarding *Synodontis schall* fish species of site 1 (46.9fl) was to be insignificantly different comparing to that level in control samples, where it was amounted to be 44.7fl. MCH pg. mean levels of *Synodontis schall* fish species (Table 1) in site 1 (20.3pg.) was slightly increase, but not significant different, comparing to that of the control site 3 (19.7 pg). With regard to MCHC (g/dl), the tested sample of *Synodontis schall* fish species caught from the contaminated site 1 (44.7 g/dl) found to be above (but not significant different) that of the control sample that amounted to 43.2 g/dl.

Hematological parameters of *Clarias lazera* fish species (commonly known as garmout): Table 2 summarizes hematological parameters of *Clarias lazera* fish species, result indicated that the highest PCV of *Clarias lazera* fish species (32.4%) was found in fish caught from site 2, seconded by that caught from site 1 (31.1%), these magnitudes were insignificant comparing to that of the control (29.6%). As shown in table 2, the magnitudes of Hb g/dl in blood of *Clarias lazera* fish species of the three sites studied were found to be almost equal to the control, where was the Hb amounted to 13.6 g/dl.

Table 1. Hematological parameters of *Synodontis schall* fish species (commonly known as gargor) caught from $Site_3$ Jebel Awlia Dam (control) and contaminated White Nile River ($site_1$)

Parameters	$Site_3$	$Site_1$	d.f-(N-2)	S.E±	P-value	Sig-level
PCV%	35.6	32.1	28	0.84	0.000	*
Hb(g/dl)	13.6	14.3	28	0.42	0.086	Ns
WBC×10³cells/µl	7.0	6.9	28	0.28	0.560	Ns
RBC×10cells/µl	6.7	6.8	28	0.19	0.444	Ns
MCV (fl)	44.7	46.9	28	1.80	0.228	Ns
MCH(pg)	19.7	20.3	28	1.85	0.748	Ns
MCHC(g/dl)	43.2	44.7	28	1.07	0.166	Ns

Ns: Not significant different ,*: Significant different at 5% & **: Significant different at1%.
PCV = pachege cell volume, Hb = hemoglobin, WBC = white blood cell, RBC = red blood cell, MCV = mean cell volume, MCH = mean cell hemoglobin, MCHC = mean cell hemoglobin concentration, g/dl = gram deciliter, µl = microliter, fl = femtoliter, pg= pictogram.

Table 2. Hematological parameters of *Clarias lazera* fish species (commonly known as garmout) that caught from $site_3$ Jebel Awlia Dam (control), White Nile River ($site_1$) and treatment plant ponds ($site_2$)

Location of samples	Hematological parameters						
	PCV%	Hb g/dl	WBCx10³ cells/µl	RBC×10^6 cells/µl	MCV (fl)	MCH (pg)	MCHC g/dl
$Site_3$	29.6^c	13.6^a	6.5^a	5.7^a	49.7^a	22.6^a	43.2^a
$Site_2$	32.4^a	13.6^a	6.8^a	5.8^a	55.5^a	23.3^a	41.8^b
$Site_1$	31.1^b	13.3^a	6.6^a	5.8^a	51.5^a	23.1^a	42.7$^{a\,b}$
P-value	0.000	0.372	0.546	0.918	0.093	0.746	0.048
Sig-level	**	Ns	Ns	Ns	Ns	Ns	*
S-E±	0.74	0.29	0.38	0.26	3.76	0.95	0.72

Ns: No significant different, *: Significant different at 5%, **: Significant different at1%, means within columns which having similar letters are not significantly different at 0.05 level of probability according to DMRT.
PCV= pachege cell volume, Hb= hemoglobin, WBC= white blood cell, RBC= red blood cell, MCV= mean cell volume, MCH= mean cell hemoglobin, MCHC= mean cell hemoglobin concentration, g/dl= gram deciliter, µl= microliter. Fl= femtolitre, pg= pictogram.

As well, the WBCx10³cells/µl mean levels of *Clarias lazera* fish species of the three sites under the study were found to be almost equal to that of the control, where was the WBC amounted to 6.5x10³cells/µl. Regarding RBC×10^6 cells/µl, as shown in table 2, the two tested samples of *Clarias lazera* fish species caught from the contaminated sites not significant to that of the control sample that amounted to 5.7×10^6 cells/µl. As shown in table 2, the highest level of MCVfl regarding *Clarias lazera* fish species was that of site 2 (55.5fl), seconded by site 1, these two mean values were not significantly different comparing to that level in control samples, where it was found to be 49.7fl. MCH pg. mean levels of *Clarias lazera* fish species (Table 2) in site 1 (23.1pg) and site 2 (23.3pg.) were slightly increase, but not significant different, comparing to that of the control site 3 (22.6 pg.). On contrast, MCHC g/dl mean levels of *Clarias lazera* fish species (Table 2) in site 1 (42.7 g/dl) and site 2 (41.8 g/dl) were slightly decrease, but not significantly different, comparing to that of the control site 3 (43.2 g/dl).

shown in table 3, the tested sample of *Oreochromis niloticus* fish species caught from the contaminated site 1(5.7 10^6 cells/µl) found to be below (but not significantly different) that of the control sample that amounted to 6.3×10^6 cells/µl. As shown in table 3, the level of MCV fl regarding *Oreochromis niloticus* fish species of site 1 (56.9fl) was to be significantly different comparing to that level in control samples, where it was amounted to be 44.2fl. MCH pg. mean levels of *Oreochromis niloticus* fish species (Table 3) in site 1 (24.5pg.) was slightly increase, but not significantly different, comparing to that of the control site 3 (22.4 pg). With regard to MCHC g/dl, the tested sample of *Oreochromis niloticus* fish species caught from the contaminated site 1 (43.1 g/dl) found to be below (but not significantly different) that of the control sample that amounted to 44.8 g/dl.

Hematological parameters of *Bagrus bayad* fish species (commonly known as bayad): Hematological parameters of *Bagrus bayad* fish species were summarized in table 4, with

Table 3. Hematological parameters of *Oreochromis niloticus* fish species (commonly known as bulti) that caught from site$_3$ Jebel Awlia Dam (control) and White Nile River (site$_1$)

Parameters	Site$_3$	Site$_1$	d.f-(N-2)	S.E±	P-value	Sig-level
PCV%	29.2	31.8	28	1.00	0.017	*
Hb (mg/l)	13.3	13.7	28	0.33	0.323	Ns
WBC×10³cells/µl	6.2	6.2	28	0.29	0.956	Ns
RBC×10^6 cells/µl	6.3	5.7	28	0.35	0.057	Ns
MCV(fl)	44.2	56.9	28	3.09	0.001	**
MCH(pg)	22.4	24.5	28	1.34	0.135	Ns
MCHC(g/dl)	44.8	43.1	28	0.92	0.082	Ns

Ns: No significant different, *:Significant different at 5%, **: Significant different at 1%
PCV = pachege cell volume, Hb = hemoglobin, WBC = white blood cell, RBC = red blood cell, MCV = mean cell volume = MCH = mean cell hemohlobin, MCHC = mean cell hemoglobin concentration, g/dl = gram dicilitre, µl = microliter, fl = femtolitre, pg = pictogram.

Table 4. Hematological parameters of *Bagrus bayad* fish species (commonly known as bayad) in White Nile River caught from site$_3$ Jebel Awlia Dam (control) and White Nile River (site$_1$)

Parameters	Site$_3$	Site$_1$	d.f-(N-2)	S.E±	P-value	Sig-level
PCV%	29.4	31.7	28	0.77	0.005	**
Hb×10^6 cells/µl	12.9	13.6	28	0.34	0.065	Ns
WBC×10^3 cells /µl	5.8	6.2	28	0.26	0.166	Ns
RBCg/dl	5.1	5.3	28	0.23	0.552	Ns
MCVpg	50.2	28.5	28	5.39	0.136	Ns
MCH fd	31.4	26.0	28	2.36	0.031	*
MCHCg/dl	43.0	42.9	28	0.61	0.871	Ns

Ns: No significant different, *:Significant different at 5%, **: Significant different at 1%
PCV = pachege cell volume, Hb = hemoglobin, WBC = white blood cell, RBC = red blood cell, MCV = mean cell volume, MCH = mean cell hemohlobin, MCHC = mean cell hemoglobin concentration, g/dl = gram dicilitre, µl = microliter, fl = femtolitre, pg = pictogram.

Hematological parameters of *Oreochromis niloticus* fish species (commonly known as bulti): Hematological parameters of *Oreochromis niloticus* fish species were summarized in table 3, with regard to PCV test, PVC in blood sample of *Synodontis schall* fish in control (site 3) was found to be insignificantly lower (29.2%) than that of the contaminated water (site 1, 31.8%). With respect to Hb in blood sample of *Oreochromis niloticus* fish, no significant differences were found between fish of control water and fish of contaminated water of the White Nile River. However, slight increase (not significant) was observed of Hb in blood sample of *Oreochromis niloticus* fish of the contaminated river water (site 1) where the level was found to be 13.7 g/dl comparing to that of control (site 3) where the level was 13.3 g/dl. According to the research, the level of WBC in blood sample of *Oreochromis niloticus* fish of the contaminated water (site 1) was 6.2 ×10³cells/µl, this level was found to be equal to that of the control (site 3) where the level was also reported 6.2×10³cells/µl. Regarding RBC×10^6 cells/µl, as

regard to PCV test, PVC in blood sample of *Bagrus bayad* fish in control (site 3) was found to be insignificantly lower (29.4%) than that of the contaminated water (site 1, 31.7.8%). With respect to Hb in blood sample of *Bagrus bayad* fish, no significant differences were found between fish of control water and fish of contaminated water of the White Nile River. However, slight increase (not significant) was observed of Hb in blood sample of *Bagrus bayad* fish of the contaminated river water (site 1) where the level was found to be 13.6 g/dl comparing to that of control (site 3) where the level was 12.9 g/dl. According to the research, the level of WBC in blood sample of *Bagrus bayad* fish of the contaminated water (site 1) was 6.2 ×10³cells/µl, this level was found to be higher than that of the control (site 3) where the level was also reported 5.8×10³cells/µl. Regarding RBC×10^6 cells/µl, as shown in table 4, the tested sample of *Bagrus bayad* fish species caught from the contaminated site 1(5.3 10^6 cells/µl) found to be slightly over (but not significantly different) than that of the control sample which amounted to 5.1×10^6 cells/µl. As shown

in table 4, the level of MCV fl regarding *Bagrus bayad* fish species of site 1 (28.5fl) was to be significantly different comparing to that level in control samples, where it was amounted to be 50.2fl. MCH pg. mean levels of *Bagrus bayad* fish species (Table 4) in site 1 (26.0pg.) was found to be significantly different comparing to that of the control site 3 (31.4 pg.). With regard to MCHC g/dl, the tested sample of *Bagrus bayad* fish species caught from the contaminated site 1 (42.9 g/dl) found to be below (but not significantly different) that of the control sample that amounted to 43.0 g/dl.

DISCUSSION

Assessment of PCV level in the blood of fish species: In the present study, the mean values of packed cell volume (PCV) in *Synodontis schall* fish species of contaminated site 1 (32.1%, table 1) found to be lower than that of the control sample site 3 (35.6%), indicating the seasonal pollution of control site at Jabal Awlia Dam during the rainy season. Whereas the mean values of PCV (Table 2) in *Clarias lazera* fish species of site 2 (32.4%) and site 1 (31.1%) was found to be higher than that of the control (29.4%). Therefore, the range of PCV in blood of the studied fish species was 29.2 - 35.6%. However, the PCV levels in the studied fish species were found to be within levels that reported by some previous studies. On the other hand, the PCV optimum ranges of 44 - 49% was suggested to be in blood of healthy adult Atlantic salmon that fed an optimal diet in net sea pens (Sandnes and Waagb, 1988). Whereas Adeyemo *et al*. (2014) reported that the hematological PCV reference of cultured *Clarias gariepinus* in the Lowe Benue Basin, Nigeria, ranged between 30.08% and 39.59%. A similar study conducted by Ali (2004) was reported an increase of PCV in *Turputitora* fish species. As general, the present study revealed PCV levels similar to that reported by several previous studies which stated values for fish hematocrit (PCV) fall between 20 % and 35 % (Okafor and Chukwu, 2010). The reduction in PCV levels, reported by this study corroborates the finding of Jawad *et al*. (2004) on Indian Shad *Tenualosa ilisha* and the degree of change may be due to changes in water balance which can cause increase in blood volume and in the red blood cell resulting in decreased PCV (Cameron,1970). On the other hand, Marcos *et al*. (2007) found that the mean values of PCV were lower than that of the control in fish samples (31% and 43%). Also Salah (2001) reported a decrease in PCV. Safaa *et al*. (2011) reported higher levels of PCV values in treated groups of tilapia nilotica (*Oreochromis niloticus*). The higher level value of MCV that reported by Nilza, *et al*. (2003) was 148.8 u3 that found in Nile tilapia, and for 'pacu' was 117.6 u3 whereas in Florida red tilapia was 113.6u3. Mohammed *et al*. (2012) reported that there was no significant difference of PCV between *Clarias garipienius* collected from the White Nile and Blue Nile River. As general, it is well known that a decreased PCV indicates anemia or other complication, while the increased PCV may be caused by dehydration, and with adequate fluid intake, the PCV returns to normal.

Assessment of Hb level in the blood of fish species: The highest level value of Hb was 14.3×10^6 cells/µl (site 1) was found to be in blood of *Synodontis schall* fish species (Table 1) whereas the lowest level of 12.9 (control) was found in blood of *Bagrus bayad* fish species (Table 4). Therefore, the range of Hb in blood of the studied fish species was $12.9 - 14.3 \times 10^3$ cells /µl. The Hb optimum range of 8.9 - 10.4 g $100ml^{-1}$ was suggested by Sandnes and Waagb (1988) to be in blood of healthy adult Atlantic salmon that fed an optimal diet in net sea pens. Adeyemo *et al*. (2014) reported that the hematological Hb reference of cultured *Clarias gariepinus* in the Lowe Benue Basin, Nigeria, ranged between 9.43 and 10.99×10^6 cells/µl.

Assessment of WBC level in the blood of fish species: The highest level value of WBC was 7×10^3 cells /µl (site 1) was found to be in blood of *Synodontis schall* fish species (Table 1) whereas the lowest level of 5.8 (control) was found in blood of *Bagrus bayad* fish species (Table 4). Therefore, the range of WBC in blood of the studied fish species was $5.8 - 7 \times 10^3$ cells /µl. Adeyemo *et al*. (2014) reported that the hematological WBC reference of cultured *Clarias gariepinus* in the Lowe Benue Basin, Nigeria, ranged between 15.50 and 16.41×10^3 cells /µl.

Assessment of MCV level in the blood of fish species: The highest level value of mean corpuscular volume (MCV) was 56.9 fl (site 1) was found to be in blood of *Oreochromis niloticus* fish species (Table 3) whereas the lowest level of 28.5 fl (site 1) was found in blood of *Bagrus bayad* fish species (Table 4). Therefore, the range of MCV in blood of the studied fish species was 28.5 – 56.9 fl. Obviously, the range of MCV level of the studied fish species was found to be less than that suggested by the study conducted by Adeyemo *et al*. (2014), which reported that the hematological MCV reference of cultured *Clarias gariepinus* in the Lowe Benue Basin, Nigeria, ranged between 87.01 and 173.75 fl.

Assessment of MCH level in the blood of fish species: The highest level value of MCH was 31.4 fd was found to be in blood of *Bagrus bayad* fish species in the control site 3 (Table 4) whereas the lowest level of 19.7 fd was found in blood of *Synodontis schall* fish species in the downstream contaminated site 1 (Table 1). Therefore, the range of MCH in blood of the studied fish species was 19.7 – 31.4 fd. The findings of the present study disagreement with that reported by Ali (2004), in which MCH level in blood of *Turputitora* fish species collected from uncontaminated water (control) found to be below of that from contaminated wastewater of River Kabul. Similar findings to this study was the study conducted by Khattak and Hafeez (1996), in which reported decrease of MCH level in blood of *Cyprinion watsoni* fish species exposed to extensively used agriculture pesticide Malathion. On the other hand, the MCH optimum ranges of $94–106 \times 10^{-6}$ $g100ml^{-1}$ was suggested to be in blood of healthy adult Atlantic salmon that fed an optimal diet in net sea pens (Sandnes and Waagb, 1988). Whereas Adeyemo *et al*. (2014) reported that the hematological MCH reference of cultured *Clarias gariepinus* in the Lowe Benue Basin, Nigeria, ranged between 26.81 and 51.11 pg.

Assessment of MCHC level in the blood of fish species: The highest level value of MCHC was 44.8 g/**dl** was found to be in blood of *Oreochromis niloticus* fish species in the upstream less contaminated site 3 (Table 3) whereas the lowest level of 41.8 g/dl was found in blood of *Clarias lazera* fish species in the high contaminated ponds site 2 (Table 2). The findings of the present study is in agreement with that reported by Ali (2004) which found MCHC level in *Turputitora* fish species collected from uncontaminated water (control) and below of that from contaminated water of River Kabul sewage. Khattak and Hafeez (1996) also reported decrease in MCHC in *Cyprinion watsoni* fish species exposed to extensively used

agriculture pesticide Malathion. Adeyemo *et al*. (2014) reported that the hematological MCHC reference of cultured *Clarias gariepinus* in the Lowe Benue Basin, Nigeria, ranged between 32.61 and 33.80 g/dl.

Conclusions and recommendation: It can be concluded that most of the hematological analysis of *Synodontis schall*, *Clarias lazera*, *Oreochromis niloticus and Bagrus bayad* fish species that collected from the White Nile River effluent discharged area is not significantly ($p>0.05$) changed comparing with the control. Sewerage laboratories must conduct the necessary tests for the quality of wastewater to help reduce the metal toxicant and incidence of diseases to both fish and consumers.

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