Vet.Med.J.,Giza. Vol.48, No.1. (2000): 117-134.

SOME BIOCHEMICAL AND HISTOPATHOLOGICAL CHANGES IN PLASMA AND TISSUES OF CLARIAS LAZERA AFTER EXPOSURE TO COPPER SULPHATE APPLICATION IN A RICE FARM IN SHARKIA GOVERNORATE.

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Received: 27.6.1999
Accepted:23.10.1999

SUMMARY:

In a rice farm infested with rice scum and treated with copper sulphate (CuSO4) for 10 days in concentration of about 2.5 mg/l, the reared Clarias lazera (C.lazera) in this farm showed different biochemical deviations in their plasma and histopathological lesions in their tissues. Significant increases were presented in levels of plasma : glucose, total lipids and activities of aminotransferases (AST & ALT) and alkaline phosphatase (ALP) after 2,4, 6,8 and lo days of CuSO4 treatment.

Values of plasma: total protein, total albumin and globulin exhibited significant decreases allover the whole period of exposure to CuSO4 in the rice farm, and A/G ratios declined too at sampling times.

Significant elevations were revealed in concentrations of plasma creatinine, urea and uric acid at 2.nd, 4the and 6th days of exposure of C.lazera to CuSO4 in the rice farm, while, after 8 and 10 days of exposure, there were no significant changes in these metabolites. In addition, levels of total biliruben in plasma had no significant changes along the whole period of treatment.

The histopathological examination of gills, liver, kidney, spleen and skeletal muscles of C.lazera of the present study exhibited degenerative and necrotic changes. The lesions showed slight alterations at the first days of treatment with CuSO4. Then, the degenerative and destructive changes increased and became intensive with time. At the end of exposure period the lesions appeared more intensive and severe in addition to pronounced necrosis.

The plasma biochemical deviations and the histopathological lesions may be mainly resulted from the effect of CuSO4 exposure, while, ambient hypoxia created by rice scum showed non significant effects as indicated in controls.

INTRODUCTION

One of the most efficient ways for increasing fish production is cultivation of fish easily in rice fields without extensive efforts and money. This type of fish culture is characterized by restrictions on available places, feeding and water supplies (Saleh, 1991). In addition to overcome some requirements of fish for human being, it indirectly increases rice yield by 5-15% through the fish excrement

As well as, rice fields are affected with some plant diseases,rice scum is very effective disease for the crop, where it is caused by algae (Spirogyra spp., Class: Chlorophyceae). These algae usually cause mechanical action as competetion of rice plant and interference with their growth in addition to physiological effect as reducing water dissolved oxygen which is necessary for respiration of roots (Ibrahim et al., 1974).

Owing to the effective chemical action of CuSO4 on algal enclosures as algacide, it is used for controlling scum in the rice farm by impairment of physiological algal reactions through copper ion activity (Gustavson and Wangberg, 1995).

Catfish have special traditional value and are attractive for rural aquaculture (Pillay, 1990) because of their hardly nature, ability to remain alive out of the water for a long time, ability to feed on a variety of food stuffs and they have a good growth rate.Thus, C.lazera which are widely distributed in Egypt are reared in the rice farms which become diseased with rice scum and treated with CuSO4. These fish showed toxic effects due to the internal available copper concentration exeeds the capacity of physiological biochemical detoxification processes (Rainbow, 1992). This problem of toxicity may be caused due to accumulation of the most CuSO4 in the vital organs and tissues of the fish (Zyadah, 1997).

Then, the presence of C.lazera in a rice farm infested with rice scum and treated with CuSO4 is linked to biochemical, physiological and histopathological events as adverse effects on the fish. Therefore, the determination of some of these adverse events is the aim of this study.

MATERIAL AND METHODS

Collection of samples:

At the end of June, seven days after rice transplantation from nursery, fingerlings of C.lazera were released in rice farms with other fish species and with water of irrigation. The basal ferti-

lizers of rice fields were applied once during the final harrowing. Then as described in previous study of Shalabi (1999), C.lazera from the same rice farms and their blood samples for this reaserch were collected and handled at the end of July 1998 when rice scum was prevalent and after treatment with CuSO4 in rate of 1.5 Kg CuSO4/faddan to reach the concentration of about 2.5 mg/l where water of irrigation for flooding was about 15 Cm of high. The fish samples were collected after 2,4,6,8 and 10 days of treatment with CuSO4.

After blood sampling, specimens of some internal organs (liver,kidney, spleen, gills and skeletal muscles) were rapidly removed from each fish in exposed (E) and control (C) groups and were fixed in 10% neutral buffered formalin for 24-48hs. Gills were decalcified in formic acid solution (Roberts, 1978). Paraffin sections (3-5um) thick of collected fixed organs were prepared and stained with hematoxylin and eosin and examined microscopically. Also, as described in investigation of Shalabi (1999) blood samples were collected and plasma was prepared from each fish in (E) and (C) groups. Plasma was kept under-20°c till used for biochemical assays.

Biochemal assays:

Plasma: glucose, total albumin, total protein, creatinine and alkaline phosphatase (ALP) levels were measured in Centeral lab for Assays Services of Nuclear Energy Agency according to: Trinder (1969); Ratliff and Morris (1973); Doumas et al. (1981); Henery (1974) and Marsh et al.(1959) respectively. Also, by means of reagent kits used for measuring plasma levels of:

* AST and ALT activities were determined colormetrically according to Schmidt and Schmidt (1963).
* Uric acid and urea were determined enzymatically according to Barham and Trinder (1972) and Fawcett and scott (1960) respectively.
* Total bilirubin was determined colormetrically according to Sheriock(1951).
* Total lipids was determined colorimetrically according to Schmit (1964).
* Globulin concentration was calculated from the total protein minus the total albumin concentration.

Statistical analysis :

This was carried out using student's t-test according to Snedecor and Cochran (1967).

RESULTS

Treatment of rice scum with CuSO4 in concentration of about 2.5 mg/l in a rice farm in which C.lazera were reared showing some clinical signs which were recognized as stimulation of fish activity and movement at earlly stages of CuSO4.application, consequently decreased lat-

er. Typical patho-anatomic appearance including a large amount of mucus on body surface and on thegills, while the skin appeared derker in colour by time. Also, many biochemical and histopathological disturbances were estimated in these fish.

As shown in table (1) high significant increases in levels of plasma: glucose at ($P < 0.001$) and total lipids at ($P < 0.01$ and $P < 0.001$) at 2nd, 4th, 6th, 8th and 10th days of CuSO4 application in the rice field. Also, in table (2) significant elevations were revealed in the activities of plasma values of: (ALP) at ($P < 0.001$ and $P < 0.01$) aspartate amino-transferase (AST) at ($P < 0.05$ and $P < 0.01$) and alanine amino-transferase (ALT) at ($P < 0.01$) at the same periods of sampling.

High significant decreases are presented in levels of plasma: total protein at ($P < 0.01$ and $P < 0.001$) and total albumin at ($P < 0.001$), while, globulin levels showed significant and high significant declines at ($P < 0.05$, $P < 0.01$ and $P < 0.001$) and A/G ratios decreased too as presented in table (1). In addition, table (2) exhibited that the plasma concentrations of :creatinine, urea, and uric acid revealed significant rises at 2nd, 4th and 6th days of exposure of C.lazera to CuSO4 in the rice farm, while, after 8 and 10 days there was no significant changes in these metabolites. Total biliruben concentration had no significant changes allover the whole period of the treatment (table 2).

Histopathological examination for gills ,liver, kidney, spleen and muscles of C.lazera of this study showed different progressive destructive changes.

(1) **Gills:** showed congestion of the blood vessels of the secondary gill lamellae after 2 days of exposure and at 4th and 6th days post exposure severe haemorrhage and lamellar thickening (Fig1). At 8th and 10th days post exposure, gills exhibited diffuse haemorrhage at the base of the primary lamellae, sloughing of the lameller epithelium and fusion of the epithelium (Fig2 and Fig3).

(2) **Liver:** at 2nd day post treatment of Cu SO4 revealed congestion of the hepatic vasculature, slight intersinusoidal haemorrhage. Degenerative changes of the hepatic cells mainly vacular degeneration (Fig4) and some necrosis of hepatocytes were of observed. After 4 and 6 days of exposure the liver showed vacular degeneration, intersinusoidal haemorrhage, subcapsular haemorrhage, congestion of the hepatic veins, areas of hepatic necrosis,polymorphnuclear cell aggregation (Fig 5) and intercellular oedema (Fig 6). At 8th and 10th days post treatment, more necrosis of the hepatic cells in addition to the previous lesions but more severe and veins were filled with serous fluid.

Table 1: Effect of $CuSO_4$ exposure on some biochemical parameters in plasma of *C. lazera* reared in a rice farm.

Parameter \ Period of Exposure	2 days		4 days		6 days		8 days		10 days	
	C	E	C	E	C	E	C	E	C	E
Glucose mg/dl	60.660 ± 1.452	99.170 ± 2.300***	60.000 ± 1.460	86.500 ± 3.253***	63.500 ± 1.544	92.333 ± 2.871***	64.660 ± 1.763	88.166 ± 2.495***	61.660 ± 1.332	100.500 ± 2.334***
T Lipids g/l	31.333 ± 1.145	40.000 ± 1.527**	32.500 ± 1.258	38.166 ± 1.579**	30.333 ± 0.988	46.500 ± 2.045***	29.166 ± 1.166	35.666 ± 1.308**	29.666 ± 1.542	38.000 ± 2.160**
T Protein g/dl	5.320 ± 0.170	3.933 ± 0.189**	5.500 ± 0.240	3.270 ± 0.199***	5.420 ± 0.249	3.950 ± 0.125**	5.000 ± 0.120	3.833 ± 0.236**	5.620 ± 0.166	3.920 ± 0.192***
T Albumin g/dl	0.825 ± 0.038	0.475 ± 0.029***	0.855 ± 0.033	0.473± 0.037***	0.840 ± 0.030	0.445± 0.022***	0.852 ± 0.024	0.400± 0.014***	0.873 ± 0.030	0.368 ± 0.026***
Globulin g/dl	4.495 ± 0.132	3.458 ± 0.160**	4.645 ± 0.207	2.797 ± 0.162***	4.580 ± 0.219	3.505 ± 0.103**	4.148 ± 0.096	3.433 ± 0.222*	4.747 ± 0.136	3.552 ± 0.166**
A/G Ratio	0.183	0.137	0.184	0.169	0.183	0.126	0.205	0.116	0.183	0.103

Each value represents the mean ± SE (Standard error of the mean).
C = Control groups
T = Serum total
* and ** and *** mean significant difference at $P < 0.05$, $P < 0.01$ and $P < 0.001$ respectively.
Each (C) and (E) fish group was 6 fish in number.

E = Exposed groups
A/G = albumin / globulin

Table 2: Effect of $CuSO_4$ exposure on some biochemical parameters in plasma of *C. lazera* reared in a rice farm.

Parameter \ Period of Pexposure	2 days		4 days		6 days		8 days		10 days	
	C	E	C	E	C	E	C	E	C	E
AST U / L	13.500 ± 0.763	17.500 ± 0.991**	15.000 ± 0.856	19.000 ± 1.000*	14.500 ± 0.763	20.700 ± 1.382**	15.700 ± 0.881	18.700 ± 1.085*	15.170 ± 0.792	18.833 ± 1.301*
ALT U / L	5.420 ± 0.510	8.650 ± 0.599**	5.700 ± 0.542	10.050 ± 0.694**	5.920 ± 0.374	9.800 ± 0.644**	5.750 ± 0.588	10.683 ± 0.933**	5.333 ± 0.494	9.683 ± 1.103**
ALP U / L	8.700 ± 0.881	20.500 ± 1.668***	10.000 ± 1.064	21.500 ± 1.431***	8.833 ± 1.013	18.700 ± 1.229***	8.200 ± 0.749	15.200 ± 1.301**	9.000 ± 1.064	18.833 ± 1.661**
Creatinine mg/dl	1.520 ± 0.107	2.400 ± 0.273*	1.433 ± 0.088	2.000± 0.122**	1.420 ± 0.154	1.850 ± 0.076*	1.450 ± 0.117	1.600 ± 0.98	1.500 ± 0.156	1.680 ± 0.098
Uric acid mg / dl	0.400 ± 0.036	0.520 ± 0.047*	0.433 ± 0.055	0.583 ± 0.047*	0.450 ± 0.042	0.600 ± 0.049*	0.420 ± 0.040	0.400 ± 0.036	0.433 ± 0.049	0.450 ± 0.042
Urea mg / dl	2.950 ± 0.117	3.820 ± 0.225**	2.900 ± 0.098	3.400 ± 0.201*	3.000 ± 0.073	3.820 ± 0.221**	2.833 ± 0.102	3.020 ± 0.170	3.000 ± 0.105	3.200 ± 0.096
Total bilirubin mg / dl	0.500 ± 0.070	0.550 ± 0.061	0.450 ± 0.042	0.533 ± 0.070	0.433 ± 0.049	0.500 ± 0.076	0.433 ± 0.070	0.420 ± 0.47	0.500 ± 0.080	0.420 ± 0.047

Each value represents the mean ± SE C and E = mean Control and exposed groups.
*,** and *** mean significant difference at $P < 0.05$, $P < 0.01$ and $P < 0.001$ respectively.
Each (c) and (E) fish group was 6 fish in number.

Fig 1: Gill section of C. lazera from a rice farm treated with CuSo4 for 6 days showing haemorrhage and lamellar fusion (H & E X 100).

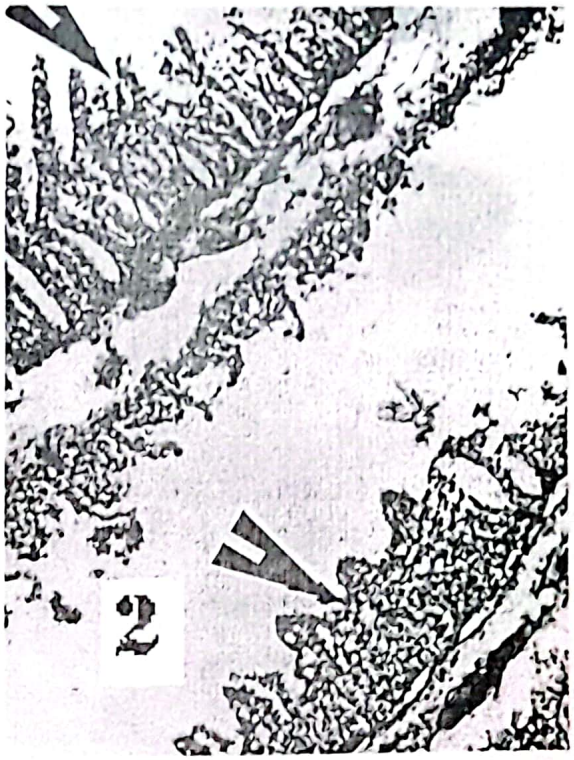

Fig 2: Gill section of C. lazera from a rice farm treated with CuSO4 for 8 days showing lamellar fusion and hypertrophy (H & E X 100).

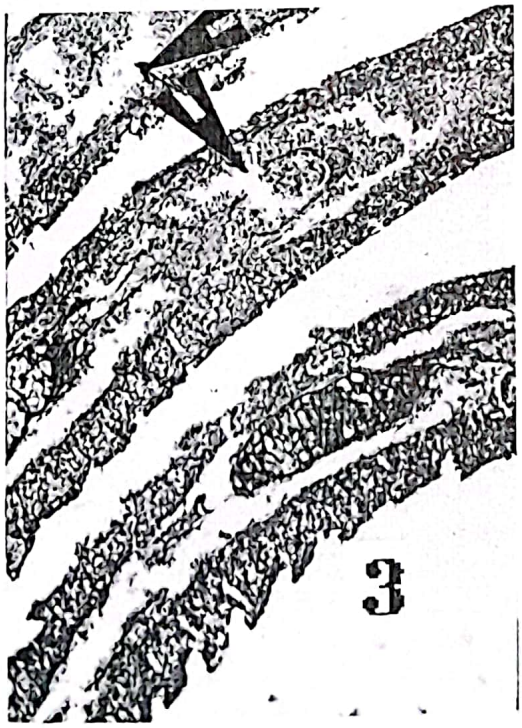

Fig 3: Gill section of C. lazera from a rice farm treated with CuSO4 for 10 days showing diffuse haemorrhage, fusion and sloughing of the lamellar epithelium (H & E X 100).

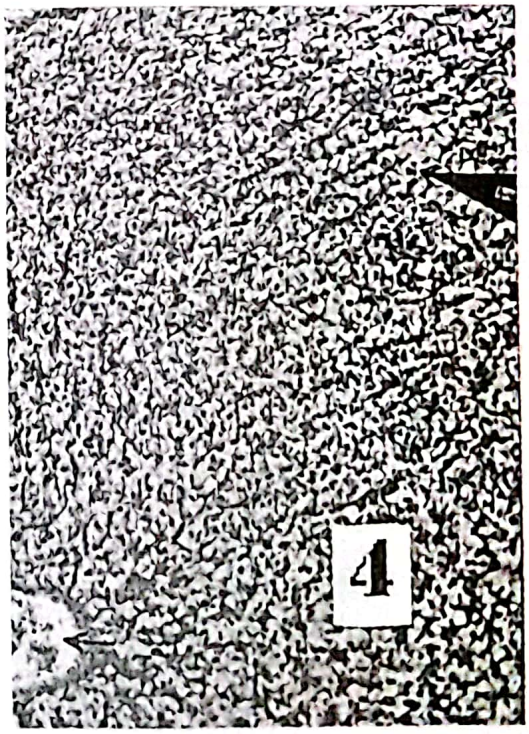

Fig 4: Liver section of C. lazera from a rice farm treated with CuSO4 for 2 days showing vacular degeneration and congestion (H & E X 100).

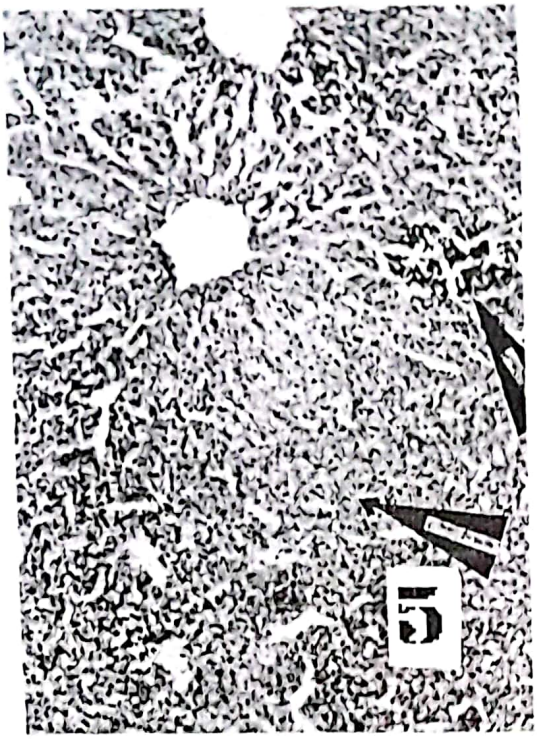

Fig 5: Liver section of C. lazera from a rice farm treated with CuSO4 for 4 days showing focal polymorphnuclear cell infiltration and necrotic hepatocytes (H & E X 100).

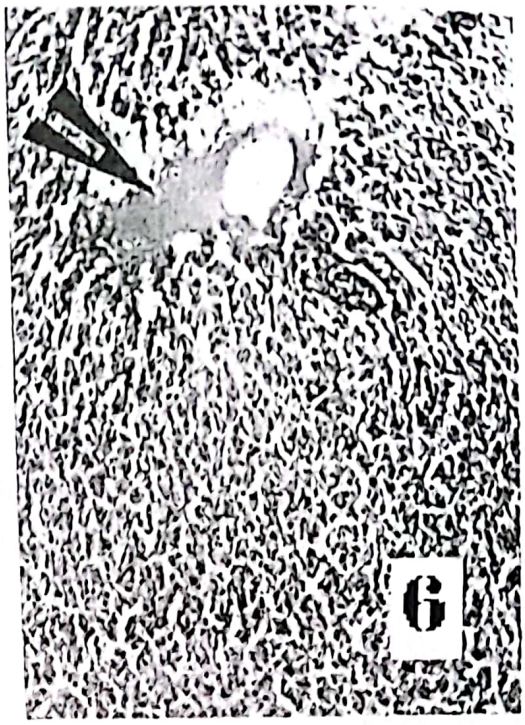

Fig 6: Liver section of C. lazera from a rice farm treated with CuSO4 for 6 days showing intercellular oedema (H & E X 100).

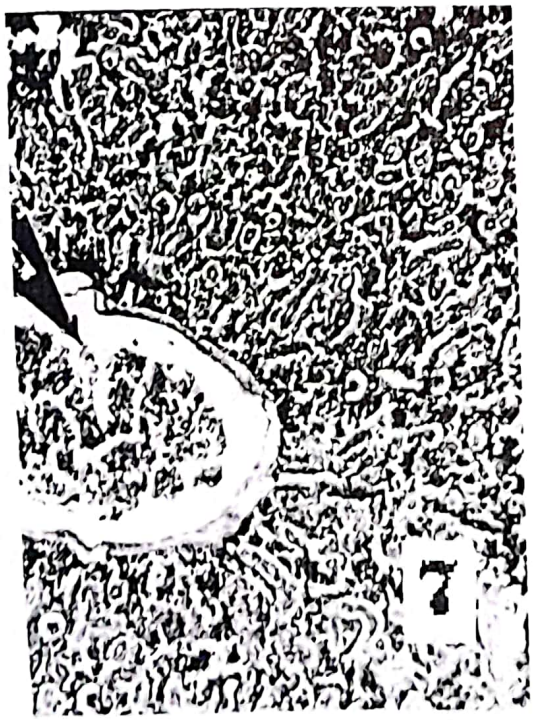

Fig 7: Kidney section of C. lazera from a rice farm treated with CuSO4 for 2 days showing focal area of haemorrhage and polymorphnuclear cell infiltration (H & E X 100).

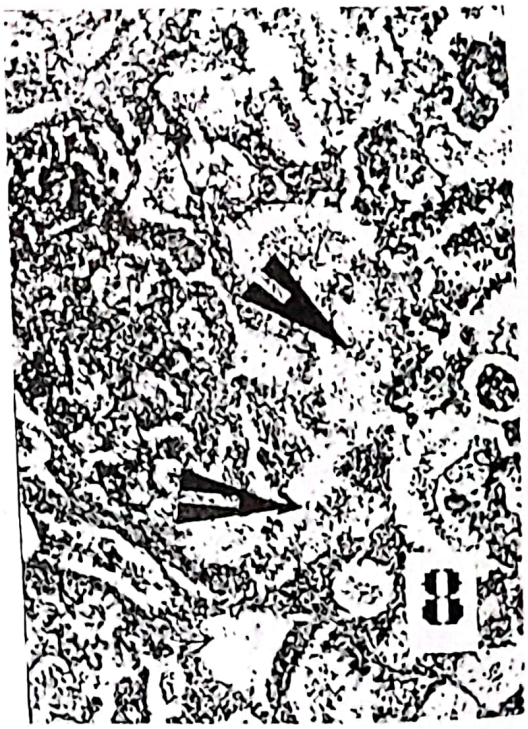

Fig 8: Kidney section of C. lazera from a rice farm treated with CuSO4 for 6 days showing intertubular oedema and polymorphnuclear cell infiltration (H & E X 100).

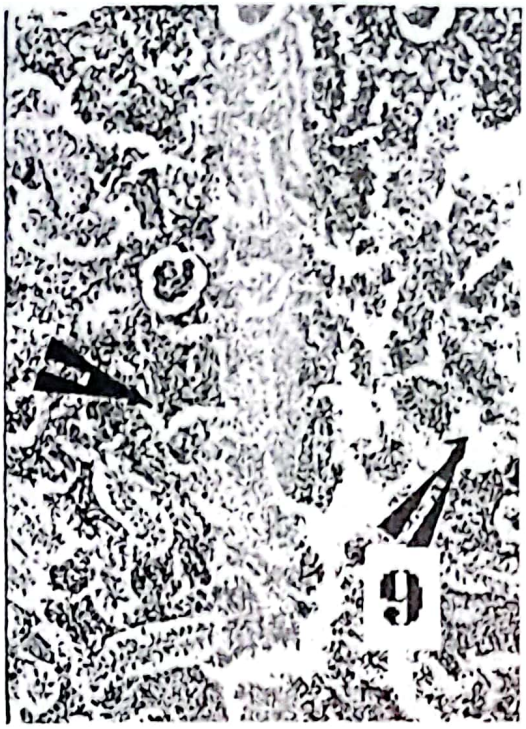

Fig 9: Kidney section of C. lazera from a rice farm treated with CuSO4 for 8 days showing diffuse polymorphnuclear cell infiltration and necrotic tubular epithelium (H & E X 100).

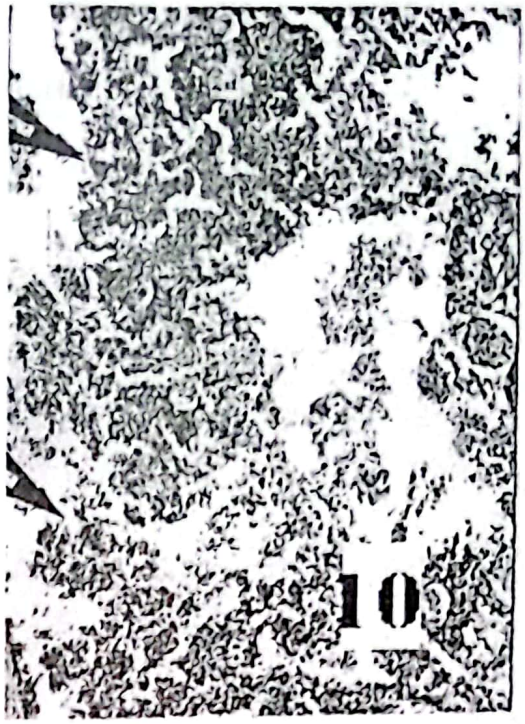

Fig 10: Kidney section of C. lazera from a rice farm treated with CuSO4 for 10 days showing diffuse mononuclear cell infiltration and tubular necrosis (H & E X 100).

Fig 11: Spleen section of C. lazera from a rice farm treated with CuSO4 for 6 days showing haemorrhage and mononuclear cell infiltration (H & E X 200).

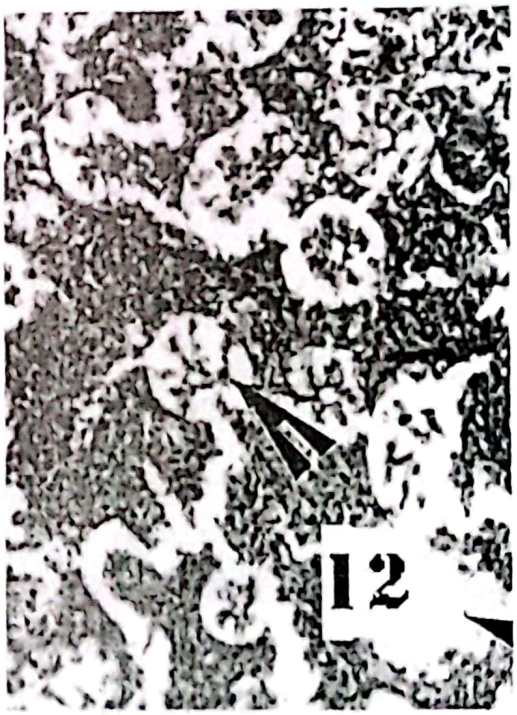

Fig 12: Spleen section of C. lazera from a rice farm treated with CuSO4 for 8 days showing oedema and lymphoid depletion (H & E X 200).

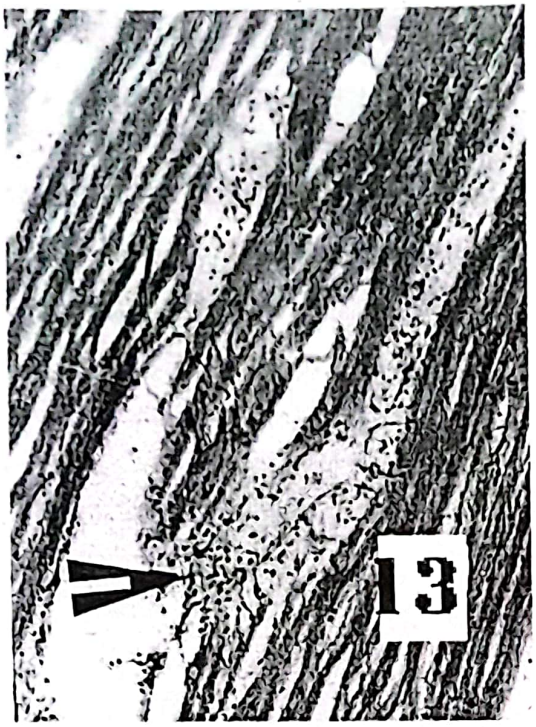

Fig 13: Skeletal muscle section of C. lazera from a rice farm treated with CuSO4 for 2 days showing interfibril polymorphnuclear cell infiltration (H & E X 100).

Fig 14: Skeletal muscle section of C. lazera from ar farm treated with CuSO4 for 6 days showin diffuse polymorphnuclear cell infiltration an oedema (H & E X 100).

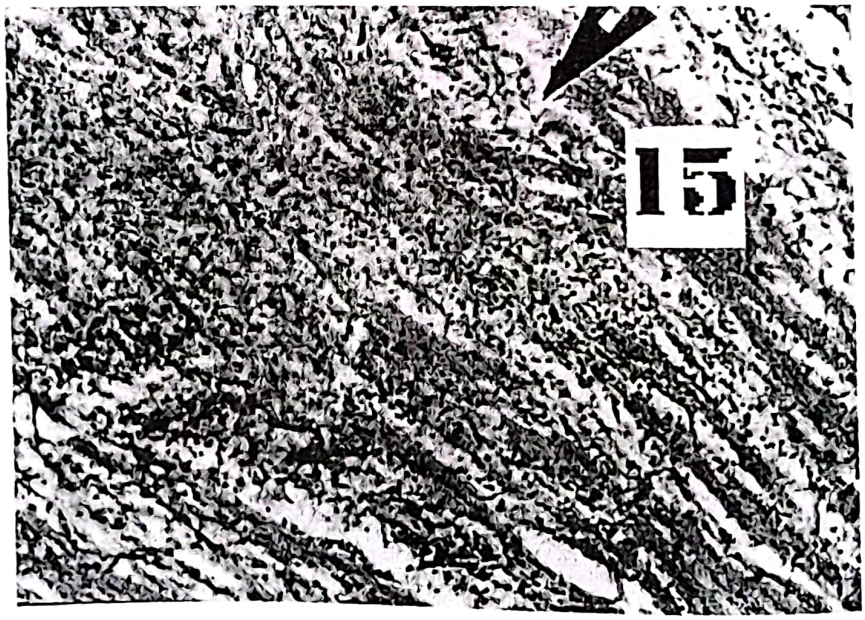

Fig 15: Skeletal muscle section of C. lazera from a rice farm treated with CuSO4 for 10 days showing myositis (H & E X 100).

(3) **Kidney:** after 2 days of treatment focal areas of haemorrhage, slight polymorphnuclear cell infiltration in the interstitial tissue (Fig7), congestion of some renal vasculature and vacular degeneration of some renal tubular epithelium were coming seen. At 4th and 6th days post exposure, the kidney showed polymorphnuclear cell infiltration, degenerative changes of the tubular epithelium and intertubular oedema (Fig 8). The lesions become more obvious and severe (Fig 9 and Fig 10) after 8 and 10 days of exposure of C.lazera to CuSO4 in the rice farm.

(4) **Spleen:** showed focal areas of haemorrhage and mononuclear cell infilration at 2nd, 4th and 6th days post exposure of fish to CuSO4 in the rice farm (Fig 11). After 8 and 10 days of treatment the spleen exhibited focal and diffuse haemorrhage, thickened blood vessels, congestion of the blood vasculature, oedema of the splenic parenchyma and lymphoid depletion (Fig. 12).

5) **Skeletal muscle:** revealed myositis with interfibril polymorphnuclear cell infiltration and haemorrhage (Fig.13) after two days from the exposure tothe CuSO4. After 4 and 6 days of treatment, the skeletal muscle showed increased myositis with polymorphnuclear cell infiltration and interfibril haemorrhage (Fig14). At 8th and 10th days of treatment, the muscles exhibited more severe myositis with interfibril oedema and polymorphnuclear cell infiltration (Fig15).

DISCUSSION

In the present study, in response to exposure to CuSO4 in a rice farm infested with rice scum, C.lazera showed significant elevations in plasma levels of glucose and total lipids to gain more energy to withstand and overcome the existing stress condition. Increased glucose levels were in harmony with several studies on fish species exposed to copper (Cu) such as : Christenesen et al. (1972); Williams and Wootten (1981); Laurén and Mc Donald (1985); Vig et al. (1987); Ghazaly (1992 C); Pelgrom et al. (1995); Mohamed (1997) and Rokaya (1998). Also, rise in total lipids in fish in response to heavy metals were recorded by Munkittrick and Dixon (1988) and Salah El-Deen (1996).

Hyperglycaemia in this study may be attributed to enhanced glycogenolysis in liver, muscles and to lesser extent gills. This breakdown of tissue glycogen as presented degenerative changes is the process for release more energy required to compensate its increasing demand as indicated in Fig 1,2 & 3 for gills, Fig 4,5 & 6 for liver and Fig 13,14 & 15 for muscles. Gluconeogenesis in teleost fish is shown to occur at high rates (Bever et al., 1981) and is thought by many to be a key process in maintaining blood glucose levels (Ca-

nsero and Amaral, 1982) especially in carnivorous fish (e.g C.lazera) with high protein and low carbohydrate diets (Higuera and Cardenas, 1986).

Lipids are an important source of potential chemical energy and may be very transient body materials and their presence or absence reflects the physiological capacity of fish (Schreck and Mayle, 1990). Blood glucose level (produced from glycogenolysis or gluconeogenesis) is a sensitive indicator in fish for environmental stress (Silbergeld, 1974) and pollution (Hatting, 1976).

In evaluation of response of C.lazera in the present study against the influence of CuSO4 with rice scum, the changes in plasma levels of: total protein, total albumin, globulin and A/G ratio were taken into consideration. Thus, significant decreases of plasma total protein values in this study were compatible with Christensen et al. (1972), Keith and Weber (1979), Rizkalla (1988), Sahlab et al. (1993), Benedetti et al. (1989), Salah-El-Deen et al. (1996) and Rokaya (1998). The reductions in these parameters as supported by the previous authors, can be attributed to several pathological processes of total protein including plasma dissolution, excretion in the urine, alteration in hepatic blood flow and haemorrhage into the peritoneal cavity and intestine. The most important cause of this result may be due to hepatic damage as indicated by Fig 4,5 and 6 and by renal necrosis as presented by Fig 7,8,9 and 10, where, this explanation is supported by Alvan (1986). Also, histopathological changes of both kidney (Fig 7,8,9 and 10) and spleen (Fig 11 and 10) of catfish was associated with decresed total protein due to bioacculation of Cu in these two organs as supported by (Aly et al .,1998). The liver demage led to its dysfunction and retardation in its efficiency for synthesis and secretion of proteins especially albumin (Alvan,1986), while, kidney damage led to renal malfunction and failure resulting in reductions of these parameters (Rokaya, 1998). This was confirmed by the negative correlation by Cu additives and serum total protein in C.lazera recorded by Rizkalla (1988).

In general, because a large proportion of serum enzymes are derived from the liver, the measurement of the activity of certain blood enzymes can provide an estimate of liver damage (Koizumi et al., 1994). Also, serum enzyme analysis of AST and ALT offer many advantages as a tool for the quantitation of liver dysfunction (D'Apollonia and Anderson, 1980). In addition, exposure of fish to heavy metal may result in stimulation, depression or no change of the enzyme activities tested depending upon the duration of exposure and dosage of this metal used (Jackim,1974).

In agreement with this study, several workers recorded significant elevation of blood aminotransferase (AST and ALT) activities in fish species after exposure to Cu (Williams and Wootten

1981; Vig et al., 1987; Seddek et al., 1992; Mohamed, 1997; Abd El-Aziz et al., 1997 and Rokaya, 1998). This result can reflect the liver damage which was shown as necrobiotic changes as the result of necrosis of parenchymatous tissue due to accumulation of Cu. This led to leakage of these enzymes from affected tissue which is considered the main source of these enzymes. Therefore, the results of the present study were correlated with histological changes in the liver of C.lazera (Fig 4,5 and 6) , where, there is reasonable good correlation between rise in these enzyme activities and the severity of histopathological lesions.In other words,these changes were due to tissue cellular injury by metals which indicated by hepatic dysfunction (Harpper et al., 1979) or myocardial infarctions (Carrol and Cowden, 1966) which caused liberation of these enzymes into blood stream following cell injury.

The elevations of the (ALP) activity in the present study post the exposure periods were in harmony with the results of Khater and El-Sheakh (1997) in tilapia species in response to stressors. This result can be attributed to increased release of the enzyme from the liver due to hepatocellular damage as revealed in Fig 4,5 and 6 as supported by Danasoury et al.(1997) who recorded risen ALP activity in different tissues of fish exposed to different stressors. Therefore, the previous authors attributed this increase in the activity of ALP due to positive correlation between the used concentrations of the toxicants and such induction effect on the enzyme activity. Disturbances in liver functions and hepatocellular damage due to stress of Cu which may also cause a discomfort in the physiological condition of the fish resulting in disturbances in AST , ALT and ALP (Wada and Kagamiyama, 1977) and (Khater and El-Sheakh, 1997) respectively.

As well as urea, creatinine and uric acid are by products of protein catabolism and excreted via kidney, their serum levels give an indication about renal function. Degenerative changes observed in gills and liver resulted in increased protein catabolism in fish exposed to a toxicant .Then the destroyed gills fail to excrete ammonia which led to elevation of total ammonia nitrogen in the circulation as supported by Ander and Roger (1996) and this result consequently made overload in the kidneys.

Increased plasma concentrations of creatinine, urea and uric acid in C.lazera of this study at 2nd, 4th and 6th days can be attributed most probably to the degenerative changes of the kidney (Fig 7 , 8 , 9 and 10) as supported by Abd-El-Aziz et al. (1997). This result is due to the action of the pollutant (Cu) on the glomerular filtration rate and its accumulation in the kidney that causing malfunction, impairment and damage of the renal cells (Reichenbach-klinke, 1972).

In harmony with the present study Ghazaly and Said (1995), Mohamed (1997) and Abd-El-Aziz et al. (1997) recorded the same results, where, creatinine is a valuable index of glomerular and renal function . Non significant changes in these parameters after 8 and 10 days post exposure in this study may be attributed to return of increased protein catabolism to normal levels and this was compatible with Zaki (1994). Then, the inflammatory reactions in the renal tissue were evident indicating the progress in the defense mechanism.

Finally, the metabolic changes of C.Lazera in this study can be explained as a typical secondary stress response is in the fish to provide energy to compensate the high energy demand and to help in maintaining of homeostasis (Schreck and Mayle, 1990). But, the primary response to stress is the stimulation of the adrenal tissue of fish (Laurén and MC Donald, 1987) resulting in increased levels of circulating glucocorticoids and catecholamines (Nakano and Tomlinson, 1967), where, both these groups of hormones are hyperglycaemic and lipaemic (Donaldson et al.,1984).

Therefore, any adverse biochemical and histological effects appeared in this study can be attributed to accumulation of Cu in the vital organs, (liver, kidney, gills, spleen and muscles) as supported by Zaki (1994) and Perkins et al. (1997). Then, hypoxia created by rice scum in the present study showed non significant changes in C.lazera as indicated in controls.Thus, the results in this study were mainly caused by Cu concentration as was similar in the study of Rokaya (1998), in which she used combined sublethal concentrations of Cu,Zn and Cd as pollutants for Tilapia nilotica, she attributed her results at first to the toxicity of Cu mainly.

In the present study, the histopathological lesions which were shown in the gills, liver, kidneys, spleen and muscles of C.lazera were more pronounced and severe.especially at 8th and 10th days of sampling.These changes were compatible with studies of Baker (1969), Schreck and Lorz (1978), Seddek et al. (1992) and Sahlab et al. (1993). The alterations in the gills, liver, kidneys, spleen and muscles of C.lazera in this study consequently impaired the biochemical and physiological functions which were considered as defense mechanism that were attributed to the necrobiotic changes in the vital organs (Readon and Harrel, 1990 and Zaki,1994).

Thus, it can be concluded that exposure of C.lazera to CuSo4 in a rice farm infested with rice scum showed adverse effects on plasma levels of many biochemical parameters and intensive different histopathological lesions in many vital organs of fish.

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