EFFECT OF AMMONIA TOXICITY ON BIOCHEMICAL PARAMETERS AND TISSUE ALTERATIONS OF NILE TILAPIA (O. NILOTICUS)

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ABSTRACT

The effects of exposures to sublethal ammonia concentrations on O. niloticus were determined with respect to histology. The experiments were conducted for four weeks and with four different ammonia concentrations 1.7, 8.7, 17.4 and 34.8 mg / L total ammonia nitrogen (TAN).

Fish exposed to different ammonia concentrations had a significant increase in almost the biochemical parameters recorded. In addition, pathologic alterations were displayed in the gills, liver and kidney.

Keywords: *Ammonia - Nile tilapia (O. niloticus) - Biochemical parameters - Histopathology.*

INTRODUCTION

O. niloticus considered one of the most important aquaculture species in Egypt. With increasing the demands for fish production; intensification of tilapia culture has been adopted. Fish reared under such conditions are often exposed to various stressors. Ammonia is one of those stressors which represent a great significance for its capability to counteract the improved performance of the cultivated species **(Ajani, 2008).** Un-ionized form of ammonia (UIA) is the most toxic form to aquatic organisms as it can readily diffuse through cell membranes and is highly soluble in liquids **(Smart 1978).** Sublethal UIA concentrations are known to cause behavioral, physiological, and histologic changes in fish and have several possible mechanisms of toxicity. These mechanisms include causing water and mineral imbalances, decreasing blood pH, altering cardiac function, and affecting ATP levels **(Tomasso 1994)**. Usually stress acts by inhibiting certain metabolic process **(Weis et al., 1981)**. Increase of AST (Aspartate aminotransferase) and ALT (Alanine aminotransferase) activities is indicative of some degree of tissue necrosis **(Niles, et al., 1998)** or of liver dysfunction and leakage of these enzymes from injured tissue into blood (**Salah El-Deen**, 1999). It's clearly observed that total protein and immunoglobulin was inhibited due to chronic exposure to stressor. High concentrations or increased durations of exposure to UIA may also increase susceptibility to bacterial, fungal, and parasitic diseases such as columnaris saprolegniosis (**Carballo et al. 1995**), and trichodiniasis as well as higher mortalities.

Histological changes include gill hyperplasia, hemorrhage, and telangiectasia, as well as degenerative changes in the kidneys and liver **(Thurston, et al., 1978; Daud, et al., 1988)**.

Because of the possible effects on fish health and survival, ammonia accumulation is of particular concern in aquaculture. Therefore, the aims of this study were to determine the effect of different UIA concentrations on some biochemical parameter with emphasis on tissue alterations in Nile Tilapia.

MATERIALS AND METHODS

Fish and experimental condition :

Apparently healthy O. niloticus with an average body weight of 120 ± 3.6 g were obtained from private farm at Alhamol, Kafr Elsheikh Governorate. Fish were kept in full glass aquaria measuring (100 x 50 x 30 cm) and maintained in aerated de-chlorinated fresh water at 25 ± 2°C for 14 days prior to use in experiments. The tested fish were kept for four weeks. Ammonia was supplied from stock tanks. Ammonium chloride (NH4Cl) was used as ammonia source. The ammonia concentrations were 1.7, 8.7, 17.4 and 34.8 mg / L TAN. The water (dechlorinated tap) in the tanks was changed once every other day in order to avoid the accumulation of toxic metabolites and decaying food. Fish were fed with commercial diet (Alhamol ration factory, Kafer Elshiakh) containing 30% crude protein at a daily rate of 3% of their body weight during the experiment. Daily maintenance and cleaning of the fish tank of faeces was done. The total ammonia concentrations (Compact photometer PF-11, MACHEREY-NAGEL, supplied with Ammonium 200 NANOCOLOR® tube tests kit - Germany), temperature (mercury thermometer) and pH (electrochemically using a Radio pH meter model 62) values were measured daily in each tank. Pre-determined total ammonia concentration, pH and temperature were used to UIA concentrations according to **Emmerson, et al., (1975)** (table1):

- Determination of TAN.
- Determination of water temperature.
- Determination of water pH.
- Finding the multiplication factor using water temperature and pH
- Multiplying the TAN and the obtained factor will result in UIA in mg/L.

2.2. Biochemical measurements:

Fish were anesthetized with benzocaine (200 mg/L) and the blood samples were collected from the caudal vein without anticoagulant for serum separation to be used in measuring blood chemistry.

Blood samples of the tested fish were collected at the time interval of 0-7-14- 21 and 28 days. Activities of (AST), (ALT), total protein, albumin and globulin were analyzed in the blood samples by using Commercial diagnostic kits produced by Human Gesellschaft für Biochemica und diagnostic mbH, Germany.

2.3. Histopathological analysis for Gills, Liver and kidney samples:

Gills, liver and kidney were fixed in Bouin's solution **(Roberts, 2001)** for histological examination, dehydrated through graded series of ethanol solutions, cleared in xylene, and embedded in paraffin. Five to six µm thick sections were prepared from paraffin blocks with a rotary microtome and were then

stained with Hematoxylin and Eosin. Histopathological changes were examined under a light microscope. Morphological techniques were performed according to **Karan, et al., (1998)**.

RESULTS

Biochemical analytic investigation :

The biochemical parameters of O.niloticus exposed to sublethal concentration of 0.1 mg/L of UIA under different exposure time as shown in Table (2). Total protein showed a significant increase (P <0.05) (5.5 and 5 g/dl at days 21 and 28 respectively) from the control at day 0 (3.9 g/dl). While the globulins showed significance increase (P < 0.05) (3.5 g/dl at day 21) from the control at day 0 (2.1). Tilapia showed a significant increase (P < 0.05) in the concentration of ALT (36 and 45 UL) and AST (59 and 76 UL at days 21 and 28 respectively) from the control at day 0 (22 and 26).

The biochemical parameters of O. niloticus exposed to sublethal concentration of 0.5 mg/L of UIA under different exposure time show in Table (3).Total protein showed a significant increase (P < 0.05) (6.4,6.2,6.8 and 6.3 g/dl at days 7,14,21 and 28 respectively) from the control at day 0 (5.4 g/dl). While the globulins showed significance increase (P < 0.05) (5.3, 5.8 and 5.3 g/dl at days 14, 21 and 28) from the control at day 0 (3.5). Tilapia showed a significant increase (P<0.05) in the concentration of ALT (56,59,58 and 56 UL) and AST (98,105,112 and 123 UL at days 7,14,21 and 28 respectively) from the control at day 0(18 and 35). While albumin showed moderate decrease (P<0.05) (1.5, 0.9, 1.0 and 1.01 g/dL at days 7, 14, 21 and 28 respectively) from the control at day 0 (1.9).

The biochemical parameters of O.niloticus exposed to sublethal concentration of 1.0 mg/L of UIA under different exposure time show in Table (4). Total protein showed a significant increase (P<0.05) (8 and 8.3g/dl at days 7 and 14 respectively) from the control at day 0 (5.4 g/dl). While the globulins showed significance increase (P<0.05) (7.1, 7.6 and 4.1 g/dl at days 7, 14 and 21) from the control at day 0 (2.5). Tilapia showed a significant increase (P<0.05) in the concentration of ALT (59, 78 and 86 UL) and AST (129, 148 and 170 UL at days 7, 14 and 12 respectively) from the control at day 0 (30 and 48). While albumin showed moderate decrease (P<0.05) (0.9 g/dL at day 7) and sever decrease (0.7 and 0.3 g/dl at days 14 and 21 respectively) from the control at day 0 (2.0).

The biochemical parameters of O.niloticus exposed to sublethal concentration of 2.0 mg/L of UIA under different exposure time show in Table (5). Total protein showed a significant increase (P < 0.05) (8.2 and 8.6 g/dl at days 7and 14 respectively) from the control at day 0 (4.3 g/dl). While the globulins showed significance increase (P < 0.05) (7.9 and 8.4 g/dl at days 7 and 14 respectively) from the control at day 0 (2.4). Tilapia showed a significant increase (P < 0.05) in the concentration of ALT (95 and 104 UL) and AST (165 and 187 UL at days 7 and 14 respectively) from the control at day 0 (26 and 45).While albumin showed sever decrease (0.3 and 0.2 g/dl at days 7and 14 respectively) from the control at day 0 (1.9).

Histopathological alteration:

The histopathologic observations for both control and different sublethal ammonia conc. exposed O.niloticus with representative at table (6) and images of the tissues displayed in Figs. Control individuals did not show any histopathological changes in the tissues of O.niloticus examined by the light microscope. Most differences between control and different sublethal ammonia conc. mainly were found in kidney, liver and gills. In the gills of O. niloticus showing moderate to sever proliferation of secondary lamellae besides congestion of branchial branches at 1.0 mg/L UIA Fig. (1) and showing sever congestion of secondary lamellae with round cell infiltrating their stroma at 2.0 mg/L UIA Fig. (2). Liver lesions consisted of slight or minimal hemosiderosis and nearly normal Hepatic architecture with slight congestion of blood vessels at 0.5 mg/L UIA Fig. (3), and hemorrhage replacing necrotic hepatocyted (lytic necrosis) at 1.0 mg/L UIA Fig. (4) and narrowing of hepatic cords besides sever congestion of blood vessels at 2. 0 mg/L UIA Fig. (5) .While kidney of fish exposed to sub lethal ammonia conc. displayed slight or minimal congestion and nearly normal architecture at 0.5 mg/L UIA Fig. (6), and necrotic renal tubular epithelium besides vacuolation of renal tubular epithelium at 0.1 mg/L UIA Fig. (7), and chronic inflammatory cells in interstitial tissue with Hypercellularity in mesangial cells Fig. (8).

RESULTS AND DISCUSSION

Ammonia is toxic not only to fish but also to all aquatic animals especially in pond aquaculture at low concentrations of dissolved oxygen. The toxic levels of unionized ammonia for short term exposure usually are reported to lie between 0.6 and 2 mg/L. The role of blood enzymes in monitoring and detecting stress or disease has led to a growing concern in using them as biochemical indicators to trace environmental pollutants **William (1997)** and **Adham et al. (1997, 1999)**.

Data of O. niloticus in this study revealed that the activities of most serum enzymes (ALT and AST) were significantly elevated in response to exposure to ammonia experiment's concentrations, with a positive correlation between concentration and enzyme level elevation, as AST increased by more than 3 fold in comparison with zero time at 2 mg /L UIA. The relation between fish intoxication and changes in both enzymes was earlier studied by several authors. In a laboratory controlled experiment, **Krajnovic´-Ozretic´ and Krajnovic´-zretic´ (1992)** recorded elevated activities of ALT in the plasma of adult gray mullets (Mugilavratus Risso) exposed to acute concentrations of CCl4, phenol and cyanide. Similarly, **Wieser and Hinterleitner (1980)** reported increased activities of ALT in serum of rainbow trout in response to sewage loading in rivers. Increased level of AST and ALT in common carp after exposure to ammonia may be due to the loss of Kreb's cycle with the result that these enzymes compensate by providing alpha ketoglutarate **(Chatty, et al., 1980 and Salah El-Deen, 1999)**. The observed changes could be also due to generalized organ system failure due to the effect of ammonia. **Das and yappan (2004)** found that the fingerlings of (mrigal, Cirrhinus mrigala) showed significant increased ALT activity in the serum, brain and gill at 4mg/ L TAN. The AST activity in the serum, brain and gill

also became significant at 8 mg/L TAN. The increase in the ALT and AST activity in the serum may be attributable to the process of either deamination or transamination due to the excess nitrogen in the organism. Total protein levels were also affected by ammonia exposure, whereas globulin increased significantly after 7 days of exposure to 2 mg /L UIA but at the contrary, albumin was decreased from 1.9±0.1 g/dL to 0.3±0.02 g/dL after 7 days of exposure to 2 mg /L UIA. The decrease recorded in total protein values may be due to the severity of the stressor, which causes osmotic imbalance. Alkahem, et al., (1998) attributed the reduction in the proteins to its conversion to fulfilling an increased energy demand by fish to cope with detrimental conditions imposed by a toxicant.

Concerning the effects of chronic ammonia exposure on O. niloticus with respect to tissue histology PersonLe **Ruyet, et al., (1998)** have shown that NH3 entered fish within15 min exposure. The first effects of contaminants usually accurate cellular and subcellular levels, starting from the first hour of contamination **(Metcalfe, 1998)**. Flis (1968), reported that chronic ammonia exposure might damage gills, liver and kidney, which may predispose the fish to numerous infections. In the present study, the important histopathological effects of chronic ammonia exposure on the gills were proliferation of secondary lamellae and hyperemia on epithelium especially at 2.0 mg/L UIA. Gills are a well known target organs in fish, being the first to react to unfavorable environmental conditions. Several authors have reported similarities rations on the gills of different fish species exposed to ammonia (**Mallatt, 1985**). **Redner and Stickney (1979)**, observed aneurysms, lamellar capillar congestion and hemorrhaging of Tilapia aureus after acute (2.4 mg/L UIA) and chronic (0.43-0.53 mg/L UIA) exposure. **Larmoyeux and Piper (1973)** determined aneurysms and fused lamella of rainbow trout (Salmogairdneri) gill epithelium cells. Furthermore, **Kirk and Lewis (1993)** reported that the gills of the rainbow trout exposed to 0.1 mg/L ammonia for 2 h exhibited deformation of the lamellae. **Salin and Williot (1991)** observed that Siberian sturgeon (Actpencerbaeri) (270 g) exposed to more than 60 mg/L of ammonia reveal a modification of the epithelium of the secondary lamellae and the base of the filament is slightly turgescent. Similar results were also confirmed by **Mitchell and Cech (1983)** with channel catfish (Ictalurus punctatus), **Malik, et al., (1986)** with common carp (Cyprinus carpio) and **Cardoso, et al., (1996)** with Lophio silurus alexandri.

Necrotic hepatocytes and hydropic degenerations on the liver were observed mainly at 1.0 and 2.0 mg/L UIA, respectively. As liver being the main organ of various key metabolic pathways, toxic effects of ammonia usually appear primarily in the liver. Ammonia can be carried by the hepatic portal vein to the liver as a nutrient and enter liver metabolic pathways (**Kucuk, 1999**). The most frequently encountered types of degenerative changes are those of hydropic degeneration, cloudy swelling, vacuolization and focal necrosis on fish exposed to different kinds of contaminants **(Hawkes, 1980 and Hinton and Lauren, 1990). Wajsbrot, et al., (1993)** observed clear signs of liver pathology in gilthead seabream (Sparusauratus) after 20 days of expo-

sure to 13 mg/L TAN (0.7 mg/L UIA).

In the present study, kidney tissues displayed necrotic renal tubular epithelium and hypercellularity in mesangial cells after being exposed to different concentrations (0.5, 1.0 and 2.0 mg/L) of UIA concentrations. The kidney is a one of the major organs of the toxic effects. **Thurston, et al., (1978)** observed hydropic degeneration in the kidney of cutt throat trout after exposure to 0.34 mg/L UIA and **Larmoyeux and Piper (1973)** determined glomeruli congestion in kidneys of rainbow trout after exposure to 0.8 mg/L UIA.

In conclusion, it's has been demonstrated that biochemical parameters of adult O. niloticus were affected under sub lethal exposure to ammonia toxicity. Therefore, it is very important that this water quality stressor (ammonia) be monitored regularly and level should be controlled through various management practices when necessary. If fish is kept at the sublethal value of ammonia, it can compromise its well-being by jeopardizing its

Table (1): Fraction of un-ionized ammonia in aqueous solution at different pH values and temperatures. Calculated from data in Emmerson, et al. (1975)

	Temperature													
pH	42.0 (°F)	46.4	50.0	53.6	57.2	60.8	64.4	68.0	71.6	75.2	78.8	82.4	86.0	89.6
	6 (°C)	8	10	12	14	16	18	20	22	24	26	28	30	32
7.0	.0013	.0016	.0018	.0022	.0025	.0029	.0034	.0039	.0046	.0052	.0060	.0069	.0080	.0093
7.2	.0021	.0025	.0029	.0034	.0040	.0046	.0054	.0062	.0072	.0083	.0096	.0110	.0126	.0150
7.4	.0034	.0040	.0046	.0054	.0063	.0073	.0085	.0098	.0114	.0131	.0150	.0173	.0198	.0238
7.6	.0053	.0063	.0073	.0086	.0100	.0116	.0134	.0155	.0179	.0206	.0239	.0271	.0310	.0369
7.8	.0084	.0099	.0116	.0135	.0157	.0182	.0211	.0244	.0281	.0322	.0370	.0423	.0482	.0572
8.0	.0133	.0156	.0182	.0212	.0247	.0286	.0330	.0381	.0438	.0502	.0574	.0654	.0743	.0877
8.2	.0210	.0245	.0286	.0332	.0385	.0446	.0514	.0590	.0676	.0772	.0880	.0998	.1129	.1322
8.4	.0328	.0383	.0445	.0517	.0597	.0688	.0790	.0904	.1031	.1171	.1326	.1495	.1678	.1948
8.6	.0510	.0593	.0686	.0785	.0914	.1046	.1187	.1361	.1541	.1737	.1960	.2178	.2422	.2768
8.8	.0785	.0909	.1046	.1204	.1376	.1566	.1773	.1998	.2241	.2500	.2774	.3062	.3362	.3776
9.0	.1190	.1368	.1565	.1782	.2018	.2273	.2546	.2836	.3140	.3456	.3783	.4116	.4453	.4902
9.2	.1763	.2008	.2273	.2558	.2861	.3180	.3512	.3855	.4204	.4557	.4909	.5256	.5599	.6036
9.4	.2533	.2847	.3180	.3528	.3884	.4249	.4618	.4985	.5348	.5702	.6046	.6373	.6685	.7072
9.6	.3498	.3868	.4249	.4633	.5016	.5394	.5762	.6117	.6456	.6777	.7078	.7358	.7617	.7929
9.8	.4600	.5000	.5394	.5778	.6147	.6499	.6831	.7140	.7426	.7692	.7933	.8153	.8351	.8585
10.0	.5745	.6131	.6498	.6844	.7166	.7463	.7735	.7983	.8207	.8408	.8588	.8749	.8892	.9058
10.2	.6815	.7152	.7483	.7748	.8003	.8234	.8441	.8625	.8788	.8933	.9060	.9173	.9271	.9389

Table (2): Biochemical parameters of examined adults *O.niloticus* (n=28) after 0, 7 14, 21 and 28 days of exposure to 0.1 mg/L unionized ammonia concentration.

Parameter / Days	Total Protein (g/dL)	Albumin (g/dL)	Globulins (g/dL)	ALT (U/L)	AST (U/L)
0	3.9 ± 0.21	1.8 ± 0.1	2.1 ± 0.18	22 ± 1.8	26 ± 1.8
7	4.1 ± 0.31	1.7 ± 0.9	2.4 ± 0.2	28 ± 1.9	35 ± 2.1
14	4.9 ± 0.33	1.8 ± 0.12	3.1 ± 0.22	35 ± 2.5	37 ± 2.6
21	5.5 ± 0.39*	2.0 ± 0.18	3.5 ± 0.21*	36 ± 3.0*	59 ± 3.9**
28	5.0 ± 0.4*	1.6 ± 0.1	3.4 ± 0.2	45 ± 3.1*	76 ± 5.8**

Results are mean values ± standard error of three replicates.

* Statistically significant ($p < 0.05$) differences.

** Highly statistically significant ($p < 0.005$) differences.

Table (3): Biochemical parameters of examined adults *O.niloticus* (n=28) after 0, 7 14, 21 and 28 days of exposure to 0.5 mg/L unionized ammonia concentration.

Parameter / Days	Total Protein (g/dL)	Albumin (g/dL)	Globulins (g/dL)	ALT (U/L)	AST (U/L)
0	5.4 ± 0.35	1.9 ± 0.11	3.5 ± 0.19	18 ± 1.2	35 ± 0.22
7	6.4 ± 0.42*	1.5 ± 0.1 *	4.9 ± 0.28	56 ± 3.9*	98 ± 0.75*
14	6.2 ± 0.43*	0.9 ± 0.05 *	5.3 ± 0.37*	59 ± 5.0*	105 ± 0.88**
21	6.8 ± 0.48*	1.0 ± 0.06 *	5.8 ± 0.42*	58 ± 4.7*	112 ± 9.8**
28	6.3 ± 0.49*	1.01 + 0.08 *	5.3 ± 0.41*	56 ± 4.9*	123 ± 10.2**

Results are mean values ± standard error of three replicates.

* Statistically significant ($p < 0.05$) differences.

** Highly statistically significant ($p < 0.005$) differences.

Table (4): Biochemical parameters of examined adults *O.niloticus* (n=28) after 0, 7 14, 21 and 28 days of exposure to 1.0 mg/L unionized ammonia concentration.

Parameter / Days	Total Protein (g/dL)	Albumin (g/dL)	Globulins (g/dL)	ALT (U/L)	AST (U/L)
0	4.5 ± 0.33	2.0 ± 0.17	2.5 ± 0.15	30 ± 2.4	48 ± 3.1
7	8.0 ± 0.56*	0.9 ± 0.07 *	7.1 ± 0.54*	59 ± 4.7*	129 ± 10.2**
14	8.3 ± 0.6*	0.7 ± 0.04 **	7.6 ± 0.6*	78 ± 6.1*	148 ± 11.2**
21	4.4 ± 0.33	0.3 ± 0.011 **	4.1 ± 0.28*	86 ± 5.4*	170 ± 15**
28	--[d]	--	--[d]	--[d]	--[d]

Results are mean values ± standard error of three replicates.

* Statistically significant ($p < 0.05$) differences.

** Highly statistically significant ($p < 0.005$) differences.

[d] Fishes did not survived to this point

Table (5): Biochemical parameters of examined adults *O.niloticus* (n=28) after 0, 7 14, 21 and 28 days of exposure to 2.0 mg/L unionized ammonia concentration.

Parameter / Days	Total Protein (g/dL)	Albumin (g/dL)	Globulins (g/dL)	ALT (U/L)	AST (U/L)
0	4.3 ± 0.32	1.9 ± 0.1	2.4 ± 0.17	26 ± 2.0	45 ± 3.3
7	8.2 ± 0.7**	0.3 ± 0.02**	7.9 ± 0.52**	95 ± 8.0**	165 ± 11**
14	8.6 ± 0.72**	0.2 ± 0.01**	8.4 + 0.61**	104 ± 8.7**	187 ± 14.5**
21	--[d]	--[d]	--[d]	--[d]	--[d]
28	--[d]	--[d]	--[d]	--[d]	--[d]

Results are mean values ± standard error of three replicates.

* Statistically significant ($p < 0.05$) differences.

** Highly statistically significant ($p < 0.005$) differences.

[d] Fishes did not survived to this point

Table (6): Histopathologic observations for both control and different sublethal UIA conc. (mg/L) exposed *O.niloticus*:

	Tissue and histopathology	Control	0.1	0.5	1.0	2.0
Gills	Hyperemia	-	-	+	++	++
	proliferation of secondary lamellae	-	-	-	+	++
	Congestion of branchial branches	-	-	-	+	+++
Liver	hydropic degeneration	-	-	+	++	+++
	necrotic hepatocyted	-	-	-	+	++
Kidney	necrotic renal tubular epithelium	-	-	-	+	++
	hypercellularity in mesangial cells	-	-	+	++	+++

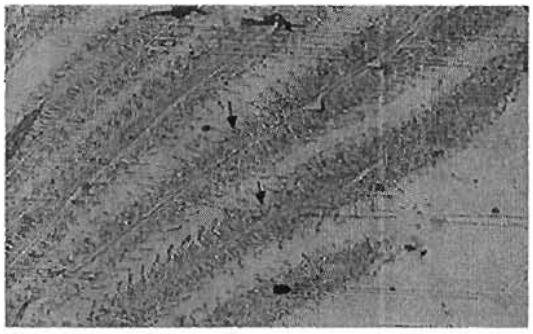

Figure 1: Section of gills of O.niloticus exposed to 1.0 mg/L UIA showing moderate to severe proliferation of secondary lamellae (arrow) and congestion of branchial branches (arrow head).

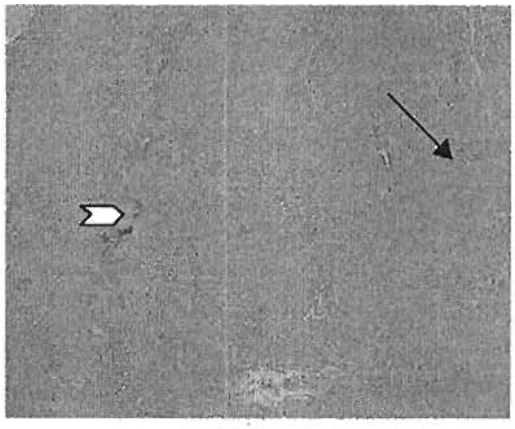

Figure 3: Section of liver of O.niloticus exposed to 0.5 mg/L UIA showing slight or minimal hemosiderosis (arrow).and nearly normal Hepatic architecture with slight congestion of blood vessels (arrow head).

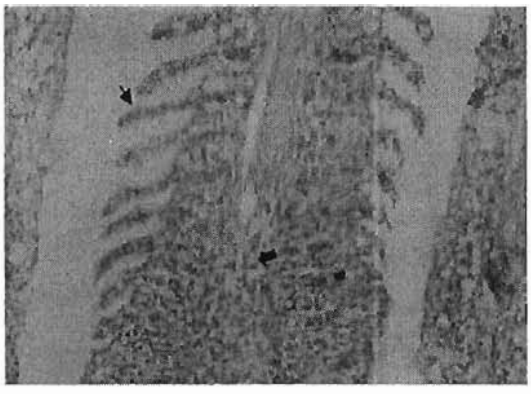

Figure 2: Section of gills of O.niloticus exposed to 2.0 mg/L UIA showing sever congestion of secondary lamellae (arrow) with Round cell infiltrating their stroma (thick arrow).

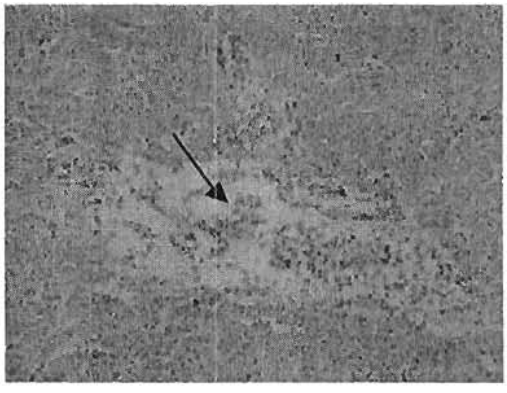

Figure 4: Section of liver of O.niloticus exposed to 1.0 mg/L UIA showing hemorrhage necrotic hepatocyted (lytic necrosis).

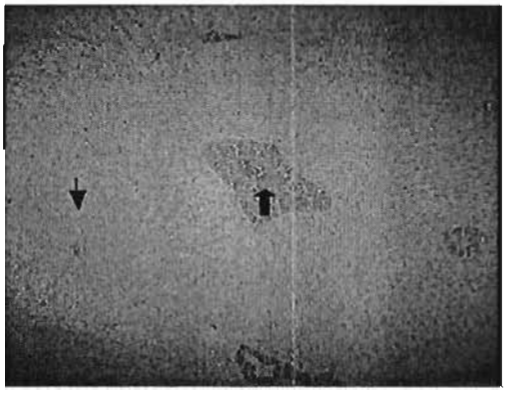

Figure 5: Section of liver of O.niloticus exposed to 2.0 mg/L UIA showing replacing narrowing of hepatic cords (thin arrow) and sever congestion of blood vessels (thick arrow).

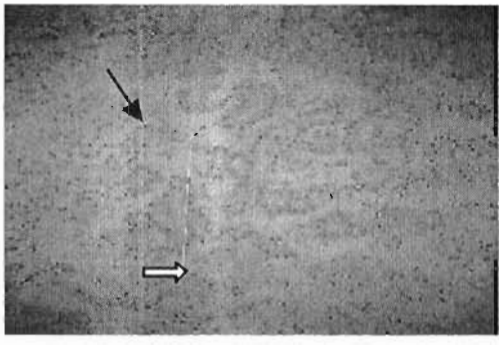

Figure 7: Section of kidney of O.niloticus exposed to 1.0 mg/L UIA showing necrotic renal tubular epithelium (thin arrow) and vaculation of renal tubular epithelium (thick arrow).

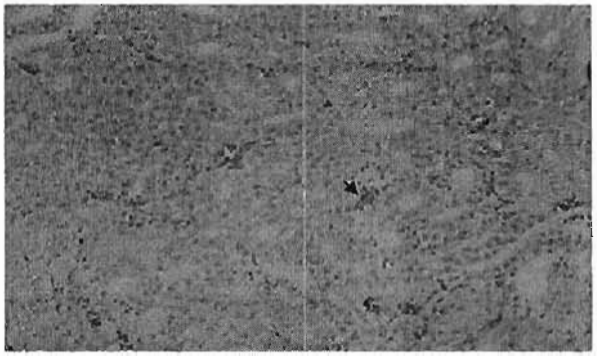

Figure 6: Section of kidney of O.niloticus exposed to 0.5 mg/L UIA showing slight or minimal congestion and nearly normal architecture (arrow).

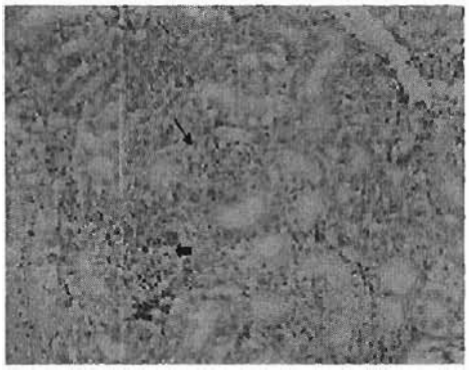

Figure 8: Section of kidney of O.niloticus exposed to 1.0 mg/L UIA showing chronic inflammatory cells in interstitial tissue (thin arrow) with Hypercellularity in mesangial cells (thick arrow).

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الملخص العربى

تأثير التسمم بالأمونيا على قياسات الدم والتغيرات فى أنسجة البلطى النيلى

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هذه الدراسة تم إجراؤها على أسماك البلطى النيلى ذات أوزان تتراوح فى حدود ١٢٠جم + ٣,٦ وتم معاملتها بتركيزات مختلفة من الأمونيا كمصدر للأمونيا وذلك بتركيزات ١,٧ -٨,٧ -١٧,٤ - ٣٤,٨ مليجرام/لتر وكانت مدة التجربة ٢٨ يوم أظهرت النتائج المتحصل عليها أن الزيادة فى نسبة الأمونيا الغير متأينة أدت إلى الزيادة الملحوظة فى بعض القياسات الكيميائية الحيوية الخاصة بمصل الدم وأيضاً أظهرت النتائج الخاصة بالأنسجة الخاصة بالخياشيم والكبد والكلى درجات مختلفة من التغيرات الباثولوجية النسيجية.