

**EFFECT OF COPPER SULFATE ON IONS BALANCE AND GROWTH
IN TILAPIA LARVAE (*Oreochromis mossambicus*)**

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The newly-hatched tilapia larvae were exposed to sub-lethal concentration Cu^{2+} (0, 30, 50 and 100 $\mu\text{g/L}$) and lethal concentration Cu^{2+} (0, 200 and 400 $\mu\text{g/L}$) for 24-96 h. Following the larval development, a whole-body Cu^{2+} concentration was dramatically increased and the amount of Cu^{2+} accumulation indicated a dose-response relationship with the ambient level of Cu^{2+} when the Cu^{2+} concentration was lower than 400 $\mu\text{g/L}$. Furthermore, the Cu^{2+} accumulation was significantly increased following the Cu^{2+} exposure time until 96 h. Cu^{2+} in the medium revealed a dose-response effect on the Na^+ , K^+ , and Ca^+ contents in larvae. Changes of the Na^+ and K^+ contents were statistically significant when larvae exposure with higher than 100 $\mu\text{g/L}$ Cu^{2+} and exposure time over 72 h. Calcium contents also appeared to decrease significantly in tilapia, that exposure with higher than 200 $\mu\text{g/L}$ Cu^{2+} for 24 h. However, Na^+ and K^+ content caused significant increase of 17-23% in larval as compared to the control when larvae exposure to low concentration of Cu^{2+} (30-50 $\mu\text{g/L}$) for 24-72 h. Copper did not cause any significant effect on body Cl^- and osmolality content in tilapia larvae as compared to the control. However, there was a restored phenomenon in the larvae exposure 100 $\mu\text{g/L}$ Cu^{2+} between 24 and 72 h. The water content did not significantly decrease at any dose of Cu^{2+} exposure between 24 and 72 h, but it appeared statistically significant decreasing until the larvae exposure Cu^{2+} for 96 h. The growth of tilapia larvae was significantly suppressed when they were exposed to 100 $\mu\text{g/L}$ Cu^{2+} over 72 h. These results suggested that the sensitivity to Cu^{2+} in larval development was more evident than others stage. Furthermore, the

larvae were able to restore or regulate ions and osmolality when they were exposed to low dose of Cu²⁺ or at short time.

Table 1. Comparison of whole-body Na⁺ contents (µg/larva) of new-hatching larvae exposed to different levels of waterborne Cu²⁺ for 24 to 96 hr.

Brood1				
Exposure Time (hr)	Concentration of Copper (µg/L)			
	0	30	50	100
24	1.85±0.02 ^a	1.85	2.17±0.30 ^b	1.89±0.40 ^a
72	1.92±0.24 ^a	2.43±0.39 ^a	1.76±0.20 ^a	1.84±0.32 ^a
96	6.93±0.42 ^a	4.77±0.42 ^b	3.08±0.62 ^b	3.13±0.58 ^b

Brood2			
Exposure Time(hr)	Concentration of Copper (µg/L)		
	0	200	400
24	3.63±0.15 ^a	2.43±0.16 ^b	1.81±0.19 ^b
72	4.51±0.21 ^a	2.02±0.25 ^b	1.58±0.21 ^b
96	5.17±0.11 ^a	1.92±0.43 ^b	-----

Mean±SD (n=4-6) is indicated

---- No data available due to the larvae died

Different superscribed letters indicate significant difference ($p<0.05$) among treatments (ANOVA analysis with Tukey's comparison were using)

References

- Berntssen, M.H.G., K. Hylland, S.E. Wendelaar Bonga and A. Maage. 1999. Toxic levels of dietary copper in atlantic salmon (*Salmo salar* L.) parr. Aquat. Toxicol. 46: 87-99
- Dang Z.C., AC.F. Robert Lock, E.S. Gert and B. Wendelaar. 1999. Metallothionein response in gills of *Oreochromis mossambicus* exposed to copper in fresh water. Amer. Physiol. 277: 320-331

- Dethloff G.M., D. Schlenk, T.H. Jonathan and H.C. Bailey. 1999. Alteration in physiological parameters of rainbow trout (*Oncorhynchus mykiss*) with exposure to copper and copper/zinc mixtures. *Ecotoxicology and Environmental Safety*. 42: 253-264
- Hwang P.P. and C.H. Yang. 1997. Modulation of calcium uptake in cadmium-pretreated tilapia (*Oreochromis mossambicus*) larvae. *Fish Physiol. Biochem.* 16: 403-410
- Li J., E.S. Quabius, S.E. Wendelaar Bonga and G. Flik. 1998. Effect of water borne copper on branchial chloride cells and Na/K ATPase activities in Mozambique tilapia (*Oreochromis mossambicus*). *Aqua. Toxicol.* 43: 1-11
- Marr J.C.A., J. Lipton, D. Cacela, J.A. Hansen, H.L. Bergman, J.S. Mayer and C. Hogstrand. 1996. Relationship between copper exposure duration, tissue copper concentration, and rainbow trout growth. *Aquat. Toxicol.* 36: 17-30
- McGeer J.C., C. Szebedinszky, D.G. McDonald and C.M. Wood. 2000. Effects of chronic sublethal exposure to waterborne Cu, Cd or Zn in rainbow trout. 1: Iono-regulatory disturbance and metabolic costs. *Aqua. Toxicol.* 50: 231-243
- Nussey G., J.H.J. Van Vuren, H.H. Du Preez. 1996. Acute toxicity tests of copper on juvenile Mozambique tilapia, *Oreochromis mossambicus* (Cichlidae), at different temperatures. *S. Afr. J. Wildl. Res.* 26: 47-55
- Perkins E.J., B. Griffin, M. Hobbs, J. Gollon, L. Wolford and D. Schlenk. 1997. Sexual differences in mortality and sublethal stress in channel catfish following a 10 week exposure to copper sulfate. *Aqua. Toxicol.* 37: 327-339
- Perschbacher P.W. and W.A. Wurts. 1999. Effects of calcium and magnesium hardness on acute copper toxicity to juvenile channel catfish, *Ictalurus punctatus*. *Aquaculture* 172: 275-280

Postlethwaite E.K. and D.G. McDonald. 1995. Mechanisms of Na⁺ and Cl⁻ regulation in freshwater adapted rainbow trout (*Oncorhynchus mykiss*) during exercise and stress . J. Exp. Biol. 198: 295-304

Priya K., K.P.B. Dinesh, M. Ramesh, R. Manavalaramanujam. 1999. Impact of copper sulphate toxicity on plasma electrolytes of a freshwater teleost fish, *Cyprinus carpio var. communis*. Indian J. Fish. 46: 173-177

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