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IMPACTS OF *MORINGA* DIETS ON GLYCOGEN CONTENT IN COPPER EXPOSED *FISH, CYPRINUS CARPIO*

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ABSTRACT Tissue glycogen content was drastically reduced in copper exposed fish as compared to control fish, even though both of them received the control diet. The decline of glycogen content was related to an extension of ex-period. However, the glycogen content was significantly ($P < 0.05$) improved in copper exposed fish fed with *Moringa* leaf meal diets. The increment of tissue glycogen was corresponding to *Moringa* levels in the diets and exposure period. Among the diets, copper exposed *C. carpio* received 30% *Moringa* diet (M2) elicited the improvement of tissue glycogen as compared to other diets.

KEYWORDS : glycogen, *moringa*, copper

INTRODUCTION

Natural as well as anthropogenic actions are the sources of heavy metal pollution including point sources such as emission, effluent, smelting, mining, discharge from industry and vehicle exhaustion. The non-point sources are the use of pesticide and municipal wastes in agriculture and disposal of industry (Lone *et al.,* 2008). Copper is used as electroplating, smelting and refining processes (Rai and Pal, 2002) and their wastes pollute. Metals and pesticides, in particular have a tendency to accumulate and undergo food chain magnification (Vinikour *et al.,* 1980). They could also cause catastrophic diseases like Minamata and Itai-Itai. Some of these organisms, like fish, are consumed by human beings. Hence, reduction of toxic elements in aquatic environments by acceptable method is needed.

The use of plant species for cleaning polluted soil and water names as phyto-remediation, has gained increasing popularity due to the less cost-effective and no side effects than physical and chemical approaches (Ali *et al.,* 2013). Numerous plant species have been identified and examined for their potential in reducing different heavy metal toxicity. Among them, *Moringa oleifera,* is the new challenge of tradition medicinal plant use both in *in vitro* and *in vivo* for reducing metal toxicity in environment and living organisms (Gopala Krishnan *et al.,* 2016; Roopashree Mallya *et al.,* 2017). Hence, the present study has been undertaken to investigate the effects of dietary *Moringa* leaf on the reduction of copper toxicity in fish and improvement of selected biochemical parameters in *Cyprinus carpio.*

MATERIALS AND METHODS

For the experiment, active and healthy juveniles of *C. carpio* were collected from the acclimation tank and starved for 24 hr prior to the commencement of the experiment. They were divided into six groups and maintained with chosen sublethal levels of copper (0.5 ppm or mg l^{-1} i.e. one third of the LC_{50} value of Cu) for 80 days. Group 1 served as control and reared in freshwater and fed with control diet (C). Test animals belonging to 2^{nd} – 6^{th} groups were exposed to 0.5 ppm copper. Among the copper exposed groups, 2^{nd} was fed with control diet (M0), however, 3^{rd} (M1), 4^{th} (M2), 5^{th} (M3) and 6^{th} (M4) groups were fed with 0, 20, 30, 40 and 50% *Moringa* leaf meal diets respectively. Each group consisting of 20 individuals was reared in circular epoxy coated cement tank containing 100 *l* water (width: 58.5 cm; height: 40 cm; capacity: 120 *l*). Triplicates were maintained for corresponding experimental diets. The experimental copper media were changed once in 2 days and fresh sublethal level of copper was prepared to maintain the constant toxicant in the medium (Sprague, 1971). The glycogen content of liver, muscle and gill was estimated by adopting the method of Kemp and Kits (1954).

RESULTS

Liver registered the more amount of glycogen followed by muscle and intestine. Tissue glycogen content was drastically reduced in copper exposed fish as compared to control fish, even though both of them received the control diet. The decline of glycogen content was related to an extension of ex-period. However, the glycogen content was significantly ($P < 0.05$) improved in copper exposed fish fed with *Moringa* leaf meal diets. The increment of tissue glycogen was corresponding to *Moringa* levels in the diets and exposure period. Among the diets, copper exposed *C. carpio* received 30% *Moringa* diet (M2) elicited the improvement of tissue glycogen as compared to other diets . Duncan multiple range test also confirmed that, tissue glycogen was significantly ($P < 0.05$) improved in copper exposed fish received 30% *Moringa* diet as compared to other diets. A significant ($P < 0.01$) and positive correlation was obtained between glycogen content and copper exposed fish received *Moringa* diets while the trend was reversed in copper exposed fish received control diet (Table.1). It showed that, *Moringa* diets reduced the copper toxicity in fish which in turn enhanced the glycogen content. Similar trend was obtained in muscle and intestine tissues also.

DISCUSSION:

The reduction of glycogen in copper exposed fish tissues indicating the excess utilization of glycogen to withstand copper induced toxicosis. Copper exposure may stimulate hormones that accelerate glycogen breakdown or inhibition of those associated with glycogen synthesis (Sahib *et al.,* 1983). Among the tested tissues, liver showed the maximum reduction of glycogen followed by gill and muscle. James *et al.* (1995) found that liver showed maximum of tissue glycogen, followed by gill and muscle in *H. fossilis* exposed to mixtures of copper and ammonia. Physiologically, the liver requires more energy than gill and muscle for storage, inter-conversion and detoxification and hence, demands maximum energy. Next to liver, carbohydrate metabolism of the gills was most affected.

Table 1. Effect of dietary supplementation of *Moringa* diets on tissues glycogen content (mg g^{-1} wet tissue) in copper exposed common carp, *Cyprinus carpio* as a function of time. Each value is the mean

Exposure period (days)	Control	Experimental diets				
		M0	M1	M2	M3	M4
	Muscle					
0	4.17 ± 0.13	4.17 ± 0.13	4.17 ± 0.13	4.17 ± 0.13	4.17 ± 0.13	4.17 ± 0.13
20	^{a}4.45 ± 0.40	^{d}2.43 ± 0.22	^{c}3.19 ± 0.19	^{b}3.78 ± 0.30	^{bc}3.60 ± 0.22	^{bc}3.44 ± 0.20
40	^{a}4.60 ± 0.34	^{c}2.03 ± 0.27	^{b}3.70 ± 0.40	^{b}3.97 ± 0.27	^{b}3.83 ± 0.22	^{b}3.76 ± 0.16
60	^{a}4.82 ± 0.34	^{d}1.70 ± 0.18	^{c}3.94 ± 0.24	^{a}4.53 ± 0.43	^{bc}4.10 ± 0.17	^{bc}4.03 ± 0.28
80	^{a}5.13 ± 0.19	^{d}1.31 ± 0.20	^{c}4.10 ± 0.14	^{a}5.02 ± 0.20	^{bc}4.78 ± 0.10	^{b}4.57 ± 0.47

	Liver					
0	8.13 ± 0.19	8.13 ± 0.19	8.13 ± 0.19	8.13 ± 0.19	8.13 ± 0.19	8.13 ± 0.19
20	^{a}8.49 ± 0.23	^{a}4.67 ± 0.20	^{d}5.14 ± 0.37	^{b}6.48 ± 0.43	^{c}5.80 ± 0.40	^{cd}5.40 ± 0.18
40	^{a}8.77 ± 0.30	^{d}4.02 ± 0.34	^{c}6.05 ± 0.15	^{b}7.40 ± 0.40	^{c}6.42 ± 0.20	^{c}6.17 ± 0.17
60	^{a}9.20 ± 0.23	^{c}3.81 ± 0.14	^{d}6.79 ± 0.19	^{b}8.55 ± 0.30	^{c}7.58 ± 0.30	^{c}7.37 ± 0.30
80	^{a}9.83 ± 0.47	^{f}3.30 ± 0.19	^{c}7.10 ± 0.12	^{b}9.22 ± 0.27	^{c}8.47 ± 0.40	^{d}7.82 ± 0.22
	Gill					
0	3.98 ± 0.23	3.98 ± 0.23	3.98 ± 0.23	3.98 ± 0.23	3.98 ± 0.23	3.98 ± 0.23
20	^{a}4.19 ± 0.17	^{c}2.93 ± 0.20	^{b}3.23 ± 0.33	^{a}3.85 ± 0.13	^{a}3.81 ± 0.20	^{b}3.40 ± 0.20
40	^{a}4.84 ± 0.29	^{d}2.27 ± 0.23	^{c}3.50 ± 0.22	^{b}4.12 ± 0.21	^{b}4.02 ± 0.19	^{bc}3.88 ± 0.23
60	^{a}4.18 ± 0.22	^{d}1.98 ± 0.30	^{c}3.79 ± 0.40	^{a}4.73 ± 0.37	^{a}4.48 ± 0.17	^{b}4.07 ± 0.33
80	^{a}5.18 ± 0.21	^{d}1.78 ± 0.19	^{c}4.00 ± 0.10	^{a}5.04 ± 0.14	^{b}4.74 ± 0.26	^{c}4.34 ± 0.30

Values (mean ±SD) with different superscript in the same row are significantly different (P<0.05)

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