Effect of Different Artificial Diets on Growth Rate Condition and Histological Structure of Nile Tilapia (*Oreochromis niloticus*)

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**Abstract:** The present study on 120 fish (*O. niloticus*) were rearing in three ponds during 5 months (2008) at El-Kanater station. Pond I was untreated group, ponds II and III were treated by vitamin C and Cobalt chloride respectively. This conducted to demonstrate the effect of vitamin C and CoCl₂ to illustrate the best treatment that gives the maximum growth rate and alleviation of pollution effects on some tissues (Kidney and Intestine). The results showed noticeable increase in growth rate of fish reared in Vitamin C and CoCl₂ than in untreated group. In addition to the some histopathological changes in kidney and intestine of fish reared at pond I (untreated group) due to the pollution of the Nile water. However, improvement was observed in the sample collected from the ponds treated with vitamin C and CoCl₂.

**Key words:** Treatment, Vitamin C, CoCl₂, growth rate, histopathology, *Oreochromis niloticus*.

**INTRODUCTION**

Tilapia species is considered one of the important fish in different aquaculture system due to their rapid growth, high tolerance to various environmental conditions, efficient feed conversion, and disease resistance[1].

Many compounds such as hormones, vitamins and mineral salts were added to the fish food to increase metabolic functions and biochemical reactions in fish bodies[2]. Vitamins are important nutrients in the supplementary diets of most fish species[3]. The absence or relative deficiency of the vitamins in the diets leads to decrease fish appetities, metabolic activities and consequently to the diseases[4].

Vitamin C (L. Ascorbic acid) has a highly efficient role in growth rate and reproduction of different fish species[5]. The fish depend upon an exogenous source of vitamin C, as they can not synthesize it and acts as cofactor for many enzymes in animal bodies and is important for formation of bones, cartilage and blood capillaries.

The National Research Council NRC[6] indicated that, vitamin C requirement for Tilapia species is 50 m/kg diet. Whereas,[4] reported that, increasing the level of vitamin C to 50 mg/kg diet for *O. niloticus* gives the best growth and feed utilization.

Cobalt salts in the form of cobalt chloride and cobalt nitrate have an important role in fish culture systems for improvement of fish production[7] noticed that, the survival rate and growth rate of fish have been increased with cobalt chloride than cobalt nitrate and without cobalt salts. The authors added that, the addition of cobalt chloride to tilapia diets leads to better growth and optimum feed utilization.

The selection of the Nile tilapia, *O. niloticus* for the present study is due to its important role in the Egyptian fisheries. These fish species were also ideally suitable for different culture systems because they are disease resistant, reproduce easily and can tolerate unfavorable conditions of water[8].

The present study aimed to investigate the effect of vitamin C (ascorbic acid) and cobalt chloride (CoCl₂) on the growth rate and histological structure of Nile tilapia (*O. niloticus*), Also, to illustrate the best treatment that gives the maximum growth rate and normal histological structure.

**MATERIALS AND METHODS**

The present study was carried out on hundred and twenty fish of the Nile tilapia (*Oreochromis niloticus*) collected from the River Nile at El-Kanater El-Khayria. Their average lengths were 5.3-6.0 cm and their average weights were 15.5 to 18.5 gm. The fish were divided into three groups (40/ each). Each group was kept in fiber glass rectangular pond filled aerated water. The ponds had an area 370 x 130 x 50 cm³ and were cleaned daily from faeces and uneaten food by sucking through rubber pipes.

**Basal Diet:** The reared fishes were fed with artificial diet formed from fish meal, soya bean, rice bran, wheat bran, corn yellow and oil, Table (1).

The chemical compounds were added to the basal diet as follows:
RESULTS AND DISCUSSION

Kidney: Normal kidneys of fish (O. niloticus) are composed of identical nephrons. Each nephron contains renal corpuscle that leads to a renal tubule. The renal corpuscle contains vascular capillary glomerulus that is enclosed by Bowman's corpuscle. Within the nephron, the kidney contains hematopoietic tissue and blood vessels. The renal tubules have various segmentation and accordingly appear in different shapes.

Some changes in kidney tissue have been observed in different experimental ponds. At the pond I (untreated group) the kidney revealed degeneration and necrotic change in the renal tubule, malpighian corpuscles and hematopoietic tissue (Figs.1-3). Besides, hemolysis and hemosiderene were seen in the hematopoietic tissue (Figs.4-6).

The kidney of O. niloticus rearing in pond II; Vitamin C showed degeneration in some renal tubules and malpighian corpuscles (Fig.8). In addition, slightly degeneration in hematopoietic tissues appears in (Fig.9). However, some renal tubules and malpighian corpuscles were seen in normal shape (Fig.7). In pond III (CoCl₂), the kidney tissue appeared normal the renal tubule (Figs.10-12).

Intestine: The normal intestine of fish (O. niloticus) consists of four layers: an outer serosa, muscularis, submucosa and mucosa. The mucosa epithelium consisted of columnar epithelium lined with vascular propria and mucous. Secreting goblet cells thrown into the villi.

In the present study, histopathological changes in the intestine of O. niloticus at pond I (untreated group) included degeneration and necrosis of mucosa and submucosa and destruction of muscularis. Reduction in some villii (Figs.13-17).

In pond II (vitamin C) much degeneration were observed in serosa and submucosa, but muscularis and mucosa appeared healthy (Figs.18-21). In pond III (CoCl₂) four layers structures appeared generally in a good healthy (Figs.22-24).

Growth Rates: The total length and weight of O. niloticus reared in the experimental ponds in shown in Table (2). The study found that, fish reared at ponds II (vitamin C) and III (CoCl₂) were higher in length and weight than pond I (untreated group). Also, fish reared at pond III (CoCl₂) showed increase in weight than the other ponds.

Discussion: The present study was undertaken to investigate growth rate and histological structures on O. niloticus fish under the effect of vitamin C and cobalt
Kidney of *O. niloticus* showing: degeneration and necrotic changes in the renal tubules and glomerulus at pond I (Figs.1-3) [x400]; degeneration and hemorrhages, hemolysis and hemosiderin at the same pond (Figs.4-6) [x400]; degeneration in some renal tubules, malpighian corpuscles and hematopoietic tissues at pond II (Figs.7-9) [x400]; at pond III, the kidney tissue appeared normal in the renal tubule (Figs.10-12) [x400].

**Table 2:** Growth in length and weight of *O. niloticus* fed on diets containing Vit. C and CoCl, during 5 months (mean ± SD)

<table>
<thead>
<tr>
<th></th>
<th>I (Mean ± SD)</th>
<th>II (Mean ± SD)</th>
<th>III (Mean ± SD)</th>
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<tbody>
<tr>
<td>L</td>
<td></td>
<td>W</td>
<td>W</td>
</tr>
<tr>
<td>Mean</td>
<td>0.02±0.06</td>
<td>8.87±3.75</td>
<td>0.68±0.86</td>
</tr>
<tr>
<td>1 Month</td>
<td>0.90±0.87</td>
<td>18.23±8.89</td>
<td>2.47±1.02</td>
</tr>
<tr>
<td>2 Month</td>
<td>2.50±0.83</td>
<td>23.86±0.71</td>
<td>1.83±0.99</td>
</tr>
<tr>
<td>3 Month</td>
<td>2.71±0.73</td>
<td>32.62±7.43</td>
<td>3.07±0.89</td>
</tr>
<tr>
<td>4 Month</td>
<td>2.57±1.61</td>
<td>32.66±23.74</td>
<td>4.55±1.97</td>
</tr>
<tr>
<td>5 Month</td>
<td>0.02±0.06</td>
<td>8.87±3.75</td>
<td>0.68±0.86</td>
</tr>
</tbody>
</table>

L: Growth rate in length = final in length – initial in length
W: Growth rate in weight = final in weight – initial in length
I: pond I (untreated group).
II: pond II (vitamin C).
III: pond III (CoCl).
Intestin of *O. niloticus* showing: degeneration and necrosis of mucosa and submucosa, destruction of muscularis and reduction in some villi at pond I (Figs.13-17) [X400]; degeneration in serosa and submucosa at pond II (Figs.18-21) [X400]; four layers structures appeared generally in a good healthy at pond III(Figs.13-17) [X400];

chloride salt (CoCl). At pond II, the addition of vitamin C to the supplementary diets of reared fish Nile (*O. niloticus*) was increase in growth in weight. The same observation recorded by NRC[6], they reported that, the optimal level of vitamin C in diets of reared tilapia species in 50 mg/kg diet. Moreover[10-11] mentioned that, the absence of vitamin C from fish diets leads to the reduction of growth rates.

The growth rate of *O. niloticus* in this study was improved by adding CoCl, to supplementary diets.[1] Moreover, the growth rate of *O. niloticus* was increased when the fish were fed on diets containing small doses (0.01 mg/day/fish) of cobalt salt.[12] measured the effect of CoCl, on the cardioventilatory physiology of catfish (*Ictalurus punctatus*), they revealed that, cobalt salts are used in fish culture to stimulate oxygen chemoreceptor and hypoxic reflexes.

In the present study, many samples of fish kidney and intestine from pond I (untreated group) showed some lesions may be attributed to the nature of the Nile water (that receive different pollutants) from which the samples were transferred to the experimental ponds. During 5 months, of the experimental period the samples from pond II (vitamin C) and pond III (CoCl,) showed normal structure and fish are healthy.

Similar histopathological lesions were observed in kidney of fish (*Clarias gariepinus*) collected from different areas along River Nile[13,14].

[13] studied the effect of River Nile water on kidney of *Tilapia zillii* and *Clarias gariepinus*. They found that, the kidney tissues included degeneration and necrosis of renal tubules and distortion of glomerular capillaries. [16] found injuries in kidney tissue of *Liza*
ramada fish obtained from water polluted with industrial and agricultural wastes in lake Manzalah. The kidney injuries included degeneration and necrosis of renal tubules and destruction in Malpighian corpuscles and hematopoietic tissue. The lesions in hematopoietic tissue suggest that both the osmotic and ionic regulations are impaired upon exposure to different toxicants[17].

The observed lesions were agreement in the intestine under different exposure conditions, in Tilapia zillii after exposure to phenol[18], in O. niloticus after exposure to insecticides Reldan and Lunate[19], in Tilapia fish after exposure to carbofuran[20].

Majmuder, and Burleson[21] found several lesions in the intestine of O. niloticus which caught from fish farm at El-Fayoum province. These lesions were degeneration and necrosis of epithelial cells of mucosa, aggregation of inflammatory cells in submucosa and destruction of muscularis. According to Bhatnagar et al.[22], the observed irritation and destruction of mucosa membrane of the intestine. The pathological alterations in the intestine of the fish collected from pond I are in agreement with those observed by many investigators about the effects of different toxicants on fish intestine[23,24]. Majmuder[21] found several lesions in the villar region after two-week feeding on dietary cadmium. As light vacuolation was observed in the submucosa layer. [23], the study was conducted to investigate the histological structures of the kidney and intestine of Tilapia zillii and Solea vulgaris obtained from Lake Qaroun. He showed some lesions in the kidney vascular degeneration in the epithelium of renal tubules, focal areas of necrosis, hemorrhages and hemosiderine between the renal tubules and edema in Bowman’s capsules with atrophy in the glomeruli. In the intestine, degenerative and necrotic changes in submucosa and mucosa with edema between them, dilation in blood vessels of serosa and atrophy in the muscularis and submucosa are noticed. Also, Majmuder[21] observed necrosis of tubular epithelium, hypertrophied epithelial cells of renal tubules and construction of the glomerulus in the kidney of C. mrigala exposed to Fenvalerate, While[24] found cloudy swelling degeneration in the epithelium of renal tubules in the kidney of P. limeatus cages in cambe stream, polluted by industrial, domestic and agricultural wastes.

At the end of the experimental period the samples of the pond treated vitamin C and CoCl, showed normal kidney and intestine structure. However, the samples of pond I (untreated group) showed some histological alterations. [25] reported that, vitamin C acts as a protective agent against DNA damage in normal cells.

I could conclude that, River Nile pollutants induces toxic lesions in the kidney and intestine i.e. alliterating their fine structure, but used vitamin C or CoCl, in fish food lead to treat these lesions. It is recommended that vitamin C or CoCl, essential to fish farm to protect the fish organs and human.

REFERENCES


