Effect of Aquatic Pollution on Fish (Review)

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Abstract: Aquatic pollution is still a problem in many freshwater and marine environments as it causes negative effects for the health of the respective organisms. The present literature review of the effect of pollution on fish includes, water quality, pesticide, chemical miscellaneous and physical pollution. The present study was concluded that, there were inversely and reversely proportion relationship between pollution in aquaculture and the prevalence of external and internal parasitic infestation respectively. Control measures depend mainly on strict hygienic measure from the causative agent beside specific antipollution.

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1. Introduction

Fish plays an important role, not only in human food diets but also in animal and poultry rations. It is a palatable and easily digested food which is rich in vitamins, calcium, phosphorous and iodine. In Egypt, fish is considered as a cheap food article if compared with other foods of animal origin. The flesh of healthy fish is considered as a marker for the natural aquatic environment.

Factors which vary in freshwater environment, both in terms of the physical characteristic of rivers, fish farms, lackes and the chemical composition of water. Today, we are cushioned against the vagaries of our climate by central heating and perhaps air-conditioning as well as modern agricultural- practices and food preservation techniques provide us with a constant year-round supply of food and a varied diet. We tend to forget that natural populations of animals and plants can undergo considerable changes in abundance from year to year in response to fluctuations in climate and in predator-prey relationships. Also, we tend to expect our environment to remain constant and to regard any deviations as the result of human interference. Too often we overlook the role of climatic changes, especially the frequency and seasonal pattern of rainfall, on the balance of aquatic animal and plant **(Farombi *et al.*, 2007).** Heavy metals are natural trace components of the aquatic environment, but their levels have increased due to domestic, industrial mining and agricultural activities **(Kalay and Canli 2000)**. Aquatic organisms such as fish accumulate metals to concentrations many times higher than present in water **(Olaifa *et al.*, 2004 and Noor El-Deen *et al.*, 2010).**

Pollution is induced by human being reach, directly or indirectly through substances or energy (e.g. heat) into the marine environment (including estuaries) resulting in such deleterious effects as harm to living resources, hazards to human health, hindrance to marine activities including fishing, impairment of quality for use of seawater and reduction of amenities **(Gesamo, 1980).**

This definition, plants and animals that live sea are seen as a resource which needs to be conserved. If man's activities have a harmful effect on this, resource pollution has occurred. No such accepted definition exists for freshwater, but the general concept is transferable between the two environments. Man-made alterations to water-flow rates are understandably not included in this definition, but the general perception of pollution is that it is caused by substances (e.g. chemicals) and heated effluents **(Noor El-Din, 1997)**.

Pollution as defined above is caused when the effect of the loading on the resource is unacceptable and the point at which the load of a chemical is sufficiently.

Water containing concentrations of chemicals which are below this stand are said to be contaminated a term used which indicates that the substances present in the water are at concentrations that are not harmful to the ecosystem. The use of this term can cause confusion because in other contexts, such as the purity of foodstuffs, this term is associated with harmfulness.

Aquatic pollution is still a problem in many freshwater and marine environments; it causes negative effects for the health of the respective organisms **(Fent, 2007)**. The number of studies dealing with effects of pollutants and concurrently occurring parasites is still relatively low **(Sures, 2007)**. However the effect of environmental pollutants on fish parasites varies depending on the particular parasite and pollutant that interact **(Lafferty and Kuris, *1999*).** Pollutants may affect the immune system of the fish either directly or by change water quality; that in turn may reduce the fish immunity to parasites **(Poulin, 1992).** Also, water pollution may accelerate the life cycle of the external parasites and promote their spread **(El-Seify et al, 2011).**

Osmoregulation

Fish differ from terrestrial organisms in that they have to maintain an osmotic equilibrium with the surrounding water. The body fluids in a freshwater fish have a much higher salt content than that of the surrounding water. Therefore, by simple osmosis, water is taken up into the body. As in humans, this water is filtered from the blood by the kidneys but in fish there is no resorption of water and a copious flow of urine is produced. Freshwater fish are in no danger of dehydration!

However, the kidneys retained much of the sodium and chloride from the urine in order to prevent undue loss of salt. Because fish skin is not waterproof, sodium and chloride escape from the body although the rate at which this occurs can be slowed up by the layer of mucus on the skin surface. This salt loss is restored by the active uptake of these elements via special cells in the gall**(Woo,2006).**

Some natural factors that can modify the toxicity of chemical to fish.

Temperature: controls the rate of response to toxic concentrations, increases toxicity at low temperature? and affects the ionization of some sustenance(e.g. ammonia) and dissolved oxygen (Do),reduced DO causes increased toxicity and pathological changes in gills **(Robert, 2012).**

PH: controls the chemical species present (e.g. aluminium) or degree of ionization (e.g. ammonia)**.** At the pH of the water falls below 5.5, so the harmful effects on fish begin to increase. These can be direct harmful effects on the ability of the fish to maintain their natural salt balance, especially in water with very low calcium content, or indirect effects such as that from a reduced food supply. There is a reduction in the productivity of natural waters at these low pH values because the recycling of nutrients is inhibited. Sudden increases in acidity to pH values below 4.5 may be lethal to fish; in general, the salmonid species are more resistant than other families of fish because they are adapted to living in acid water **(Noor El-Din, 1997)**.

Hardness (calcium carbonate): reduces the toxicity of divalent heavy metals**.** Humic and fulvic acid, forms low toxicity complexes with some metals **(Ahmed *et al.,* 2010).**

Changes in both temperature and the DO content of the water will affect the resistance of fish to toxic chemicals. Also, changes in temperature, PH, water hardness and humic acids can affect their toxic state of some chemicals or compete with their uptake by fish **(Zdenka *et al.,* 1993).**

Because toxic substances exert their harmful effects by interfering with normal chemical reactions within the body, the primary site of action will be within the cell. There are two ways by which such effects can be measured:

1) Direct measurements made on the concentration of various chemicals which can affect the vital processes within the cell, such as enzymes and the substrates on which they act. This can give an insight into the mode of toxic action; for example the inhibition of acetyl cholinesterase in nerve cells by organophpsphorous insecticides prevents the normal transmission of electrical impulses.

2) Other reactions measured may be connected with the detoxification mechanism for a particular chemical. For example, metals such as copper, zinc and cadmium are transported in the blood throughout the body by protein molecules known as metallolhioneins. Exposure of a fish to these metals in the water leads to an increase in the body levels of metallothioneins in order to remove them from the gills via the blood to sites where they can be safle y stored or excreted. Therefore; metallothionein analysis can be used to determine whether fish have been exposed to higher levels of heavy metals in the environmental.

Another technique is the measurement of enzymes known as multifunctional oxygenases (MFOs) that are responsible for the breakdown of organic molecules within one of the major changes in gill structure that can reflect a change in water quality concerns the relative production of certain cell types present. For example, increases; in the 1 abundance of the cells responsible for the excretion of mucus or the uptake of chloride (associated with the maintenance of osmoregulation) in relation to other types of epithelial cells. Another important use of histopathology is in the identification of abnormal cells (e.g. tumors in fish exposed carcinogenic chemicals.

Effect of some common heavy metals pollutants on fish:

Heavy metals (zinc, copper, lead, cadmium,, etc) were recorded as major fish polluting chemicals in both developed and non developed countries **(Hamelink and Spacie, 1977).**

Sources

Probably the most important heavy metals sources was, and still in some countries, the waste arising from mining activities, such as mine drainage water. Effluent from tailings ponds (where waste crushed core is settled out) and drainage water from spoil heaps. These sources can continue to discharge heavy metals into watercourses long after the original mining activities have ceased. This problem was recognized in the last century and formed one of the topics for research on the effects of pollution on fish. Another important source is the industries that use these metals in various processes especially electroplating.

1- Zinc:

Because of the relatively high solubility of zinc compounds, this metal is widely detected in freshwater. Zinc as essential element for aquatic life: for example, it occurs in the enzyme carbonic anhydrate, catalyses the formation of carbonic acid from carbon dioxide in the blood. Small amount in the water or in the diet are therefore essential. It is also follows that the organisms will have an internal mechanisms to transport zinc around the body in order to manufacture such vital enzymes. When the zinc, in the water rises to a level where the amount entering the organism through the Gills exceeds the requirement for this metal. It was originally thought that the direct toxic action of zinc on fish was to precipitate the layer of mucus on the surface of the gill, causing suffocation. While this may be true for those species which produce a copious supply of mucus. The white precipitate observed on the gills of say rainbow trout is mainly composed of disintegrating epithelial cells which may be associated with the onset of mortality. Zinc may also cause a certain amount of tissue damage by reacting with protein and this could effected the respiratory efficiency as well as the osmoregulatory of function of the gills **(Andres *et al*., 2000 and Papagiannis *et al*., 2004).**

2- Copper

Good experimental data on copper toxicity are more difficult to obtained than for zinc. In hard water, copper precipitate out as a basic carbonate which is very slow to redissolve. It is difficult to prepare experimental solution in such waters because the colloidal precipitate which can be formed is not acutely toxic and the amount of copper present in the toxic ionized form may be variable. Copper sulphate has been widely used in the past as an algaecide in fish-bearing water, at concentrations which would be toxic if the metal was present in the toxic ionized form. In practice, no fish mortalities have been reported as a result of these operations, presumably because the copper was rapidly precipitate or complexed into much less toxic form. However most, if not all, of this inactive copper will ultimately enter sediment sinks where it may have limited bioavailability for organisms living there (**Figuero *et al*., 2006**).

The acute toxic action of copper seems to be similar to that of zinc. Also, lethal effects occurring at concentration down to 10% of the threshold LC_{50}. Growth rate of fish are affected at these concentration may be due to reduction in feeding rate or increased rate of activity **(Haemelink and Spacie 1977)**.

As with zinc, the main environmental factor affecting the toxicity of copper is the calcium concentration of the water, again because of the competition, between these two ions for binding sites in the tissues of the gills and other organs. However, in contrast to zinc, salmomd species are not the most susceptible to copper toxicity; for example, perch may be three times as sensitive as rainbow trout to this metal (**Andres *et al.*, 2000)**. The reason for this difference in species sensitivity is not known and, it is possible that the toxic actions of copper and zinc are in some way slightly different.

3- Lead

Lead occurs naturally in the environment. However, most lead concentrations that are found in the environment are a result of human activities. Due to the application of lead in gasoline, an unnatural lead-cycle has consisted. In car engines lead is burned, so that lead salts (chlorines, bromines, oxides) will originated and enter the environment through the exhausts of cars. The larger particles will drop to the ground immediately and pollute soils or surface waters, the smaller particles will travel long distances through air and remain in the atmosphere. Part of this lead will fall back on earth when it is raining. This lead-cycle caused by human production is much more extended than the natural lead-cycle, and has caused lead pollution to be a worldwide issue **(Dowidar *et al.*, 2001)**.

Although lead has a high profile in human toxicology of much lesser importance for aquatic life. This is mainly due to a low solubility which limits its occurrence at significant concentration in all but very soft waters. Sub-lethal effects include the drinking of the trials of salmonid fish and his can be diagnostic of low levels of lead in the water. Some evidence of this effect has been found in Fish Rivers receiving discharges from old lead mines in mid-wales(**Figuero *et al*., 2006**).

Lead has a tendency to accumulate in tissue and organs of exposed fish resulting in hepatic and renal dysfunction with growth retardation **(Haneef *et al*., 1998).** Consequently, it could induce alterations in hematological and serum biochemical parameters **(Gill 1991**) as well as pathological changes in most body organs **(Ghalab, 1997 and Mona S. Zaki *et al.,* 2010).**

4- Mercury:

In animals, mercuric oxides cause inhibition of certain enzymes, which has several neurological effects. Next to the neurological effects vanadium can cause breathing disorders, paralyses and negative effects on the liver and kidneys. Mercuric and vanadium can cause harm to the reproductive system of male animals and rat and it is accumulated in the female placenta. Vanadium can be found in fishes and many other species. Mussels and crabs where mercuric and vanadium are strongly bioaccumulated, which can lead to concentrations of about 10^5 to 10^6 times greater than the concentrations that are found in seawater (**Figuero *et al*., 2006; Huang and Ghio, 2006; Nadal, 2007 and Zaki *et al*., 2011)**. Mercury can be taken up by fish as the inorganic form but the main route is by absorption of mercury which has been methylated by bacterial Action in sediments. However, the standards set for safe level of mercury in fish for human consumption are lower than those that affect fish, so the importance of this metal to fish population is much reduced if the public health standards are met **(Worle *et al*, 2007**).

5- Cadmium:

Cadmium metal has a high profile in human toxicology where it has been transferred at harmful concentration concentrations through food chain. In the water, the main point source is effluents from electroplating works. Also, there are numerous diffuse inputs from the widespread use of this metal as well as a few areas where cadmium is leach from geological deposits. Cadmium is strongly adsorbed onto organic and inorganic particles in the water but, although it can form soluble complex with humic substance, the toxicity is not reduced as it is with copper **(Kargın and Çoğun 1993 and Rashed, 2001)**.

6- Other heavy metals

There is much less information on the toxicity to fish of other heavy metals such as aluminum, nickel, chromium and vanadium, mainly because of their lower importance as actual pollutants in the fresh water environmental. Comprehensive reviews of the published data are available and the information should be assessed in the light of the comments which have already been made on potential source of error.

The toxicity of aluminium to fish is extremely complex as it can exists in many different chemical forms in water, depending on the pH, and these forms have differing toxicities. The most toxic chemical form is found within the range 5.2-5.8, and this may account for the reduced populations of fish found in waters with this range of acidity. As with other metals, the toxicity of aluminium is reduced when the calcium concentration of the water is increased, and added protection is also given by silicon salts(**Figuero *et al*., 2006**).

The correlation between the results of laboratory experiments and field observations on the effects of low pH and aluminium is made difficult because of the problems of controlling the acidity of test solutions to the required accuracy in the former, and the wide seasonal fluctuations in the latter which can depend on the frequency and extent of the rainfall, or, in some cases, the snow melt. It should be pointed out that these fluctuations in chemical conditions are more severe watercourses than in lakes where such changes are buffered by the large volume of water. However, effects on lake fish populations because of the feeder streams where they may breed can be subjected to intermittent harmful pulses of acidity**(Haemelink and Spacie 1977)**.

The biological activities of the different types of vegetation in the catchment area may also be a factor in affecting the acidity of the run-off water. So the effect of acid rain on fisheries is still difficult to quantify, even though the main contributing factors to the problem have been identified and in some cases the concentration effect relationships have been accurately established. But the example of acidity serves to illustrate the difficulties in establishing the harmful effects of diffuse inputs of chemicals, in this case from the atmosphere via the soil of fisheries **(Fent, 2007)**.

Effect of pollutions on fish reproduction:

Many studies found a change in behavior from the normal effect on reproduction including decrease of fertile eggs and time of reproduction interval due to herpidr and thermal effects of pollution on reproduction **(Jones and Reynolds, 1997).**

Effect of pollutions on fish parasites:

The aquatic pollution effects on parasitic infestations. The presence of pesticides, hydrocarbons, poly chlolorinated biphenyls, heavy metals and sewage affected reversely on internal parasites and irreversibly on external parasites **(Blanar *et al*., 2009).**

Control

1- Prevent causative causes of pollution.
2- Strict hygienic measured.
3- Using specific antidotes.
4- The outheroties notified the dangerous of pollution on health hazard.
5- Humic acid used as general antipollution.

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