Phenol Toxicity in Fish

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Abstract: Phenolic are compounds found in the environment which can cause fish stressed or xenobiotic. Phenol exposed fish showed disorders in the metabolic toxicity indicators as hypoglycemia, low blood urea nitrogen level (BUN) and decrease of alkaline phosphatase activity (ALP). In addition, quantitative structure-activity relationships were developed using the n-octanol: water partition coefficient (log *K*ow). Positive correlations were found with ALP, plasma glucose and hemoglobin. The perfuse skin mucous secretion was prominent in phenol intoxicated catfish. This can beexplained by the fact that skin in among the first to be in close contact with the dissolved pollutants. Hence, reactions in the skin cells are spontaneous as a protection mechanism through increasing level of mucous secretion over the body surface, forming a barrier between the body and the toxic medium, minimizing its irritation effect, thus, scavenge or even eliminates toxicants through the epidermal mucous. Nervous manifestation; skin expressed perfuse mucous, black patches with skin erosion and ulceration in the later stages. All observation were correlated to the time and dose exposure. In conclusions phenol reduces of the hormonal immune response as detected by decrease of IgM level and cortisol elevation. Suppress IgM, Thyroxin *(T4)* hormone and insulin levels.
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Introduction:

Phenol and phenolic compounds are examples of toxic chemicals acts as endocrine disruptors; which mimic or antagonize hormones and disrupt the endocrine system. It is also has great potential for compromising the immune system and increases susceptibility of fish to secondary infections (Writer *et al*., 2010). Phenols are discharged into water from the effluents of a variety of industries such as coal refineries, phenol manufacturing, pharmaceuticals, industries of resin, paint, dyeing, textile, leather, petrochemical, and pulp mill. Natural processes such as the decomposition of plant matter also contribute to phenol accumulations in the aquatic environment (BuBuikema *et al*., 1979 and Ali *et al*., 2011).

Phenols are of growing concern due to their high persistent and toxicity in the aquatic environment in addition to the difficulty in detecting them given their lack of taste and odor (Tilak *et al*., 2007). Unfortunately, there is a lack of information regarding phenol pollution and its effect in the Egyptian aquatic environment. The record level of phenol in Egyptian waste water was 0.05 ppm (Nazih *et al.,* 2008). *C gariepinus* was extensively used as fish model by many scientists to monitor microbial, pathological or environmental studies (Ibrahem *et al.,* 2011). Unfortunately, there is a lack of information about the toxicity and pathological consequences in *C. gariepinus* exposed to phenol (Ibrahem, 2011).

Phenolic compounds are xenobiotic compounds that affect anemia and disrupt the endocrine system and hormones (Writer et al., 2010). This compound is classified as toxic chronic and immunotoxic which usually found in fish tissue (Taysse et al., 1995; Mukherjee et al., 1990). Phenol waste is accumulated from human activities such as the waste from industry, pharmaceuticals, and agriculture (Buikema et al., 1979).

The phenol residue comes from industrial and pharmaceutical waste as well as and natural decomposition (Buikema et al., 1979). Red Betel (P. crocatum) is one of the most aromatic plants in which the leaves contain phenolic compounds (flavonoids and tannin) and have a high phenol content (Saputra et al., 2016). Phenolic compounds become a concern specifically because of its toxic effect in the water environment. However, this compound is difficult to detect due to the lack of taste and smell (Tilak et al., 2007). A cytotoxic activity of red betel leaves on Artemia and African catfish was tested in-vivo based on the LC50 and showed that these plants have a potential of cytotoxic compounds. (Emrizal et al., 2014).

The non-biodegradability of most synthetic polymer-based packaging as well as the increasing environmental concern by consumers and government bodies have paved the way for alternative approaches (Gross and Karla 2002). This awareness has led to a focus on eco-friendly packaging materials derived from naturally occurring polymer in order to reduce environmental pollution and ecological related problems caused by non-biodegradable plastic packaging (Shah et al., 2008). Currently, there has been an interest in edible film made from renewable and natural polymers such as proteins, polysaccharides and lipids. Among them, protein-based edible films are the most attractive due to impressive gas barrier properties, compared with those prepared from lipids and polysaccharides (Cuq et al., 1995). The properties of protein films are determined by their microstructure, which significantly varies depending on the protein structure and intermolecular interaction between polypeptide chains (Ahmad et al., 2012). The functional properties of protein-based edible films are better than those of polysaccharide and fat-based films due to the unique structure of proteins (20 different monomers), which confer a wider range of functional properties, especially a high intermolecular binding potential (Hoque et al., 2010). It has been known that protein based-films have good oxygen, carbon dioxide and lipid barrier properties (Gennadios et al., 1994; Lacroix and Cooksey 2005). Protein-based film potentially used for coating or packaging could improve shelf-life and maintain the quality of foods during storage, by serving as selective barrier to moisture transfer, oxygen uptake, light transmission, losses of volatile aroma compounds (Jongjareonrak et al., 2008). Food packaging system using plastic packaging materials typically encounters several problems involving mass transfer phenomena; atmospheric oxygen penetration into foods causes oxidation of food ingredient.

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John et al., (1994) explained that the increased cortisol in phenol treatment can be associated with fish poisoning and handling. On the one hand, Roche and Boge (2000) believed that the increase in fish stressors after a single or fraction phenol injection is due to the disturbances in cells. The damage to endocrine cells in both liver and kidneys causes an abnormal biochemical blood value that one of which plays a major role in hemoglobin. Low Hb in tannin injection treatment showed that the spread of oxygen in the body of African catfish was disrupted. Barton (1987) described that a physiological stress will cause a new homeostatic condition in fish through a changing metabolism. This response to stress is controlled by the endocrine system through the release of cortisol hormones and catecholamine.

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