Extended Abstract

Clinical Pharmacology & Toxicology Journal

2019

Vol. 3 No.1

Deltamethrin induced changes in Endocrine glands & Ionic balance in *Heteropneustes fossilis*

Suresh Kumar

CRM Jat P. G. College, India

Keywords: Endocrine gland, corpuscle of stannous, vital organ, ATPase, deltamethrin, lethal concentration, Prolactin cell, Ultimobranchial gland

Deltamethrin, is a synthetic pyrethroid contaminating in aquatic ecosystems as a potential toxic pollutant, is investigated in the present study. Deltamethrin present in the ambient medium being lipophilic in nature comes in direct contact with gills and ruptures the chloride cells membrane through which insecticide enters blood and reaches the target tissues. The impact of exposure of the freshwater fish *Heteropneustes fossilis* to two sub lethal concentrations (0.07 mg/L and 0.14 mg/L) of deltamethrin for 30 days on the physiological activities of endocrine glands i.e., Ultimobranchial gland, Corpuscles of Stannius, Prolactin cells, Na^+/K^+ ATPase, Ca^{2+} and Mg^{2+} ATPase and inorganic ions Na^+, K^+ , Caz^+ and Mg^{2+} in brain, kidney, gills, muscle and intestine was assessed. Ultimobranchial endocrine gland is one of the small glands in the pharynx that develop behind the fifth pair of gill pouches in the vertebrate embryo. Ultimobranchial gland produces the hormone calcitonin which is responsible for ionic balance in fish. Exposure to deltamethrin adversely affected all the endocrine glands and activity of Na^+/K^+ ATPase, Ca^{2+}ATPase and Mg^{2+}ATPase. However, inhibition was greater with the higher concentration (0.14 mg/L). The Endocrine glands i.e. Ultimobranchial gland, Corpuscles of Stannius and Prolactin cells are responsible for regulation of calcium and ionic balance. And these were examined by compound and electron microscopy after exposed to the lower conc. (0.07 mg/l) and higher conc. (0.14 mg/l) of Deltamethrin. The Ultimobranchial gland exhibited mild histological changes at 0.07 mg/l of deltamethrin. Decreased in the staining response of the cytoplasm & nuclear volume of Ultimobranchial gland. At higher concentration exposure severe changes were observed viz. nuclear volume exhibited further decreased with degeneration and vacuolation in the cells The AF Positive cell exhibited increased granulation, but in the AF negative cells the nuclear volume increased at lower concentration. In corpuscles of stannous gland at higher concentration sever changes were observed viz., increase in granulation, vacuolation and degeneration of cell membrane. At subcellular level decrease in mitochondrial number, endoplasmic reticulum and secretary granules was noticed at 0.07 mg/L. During exposure of higher concentration mitochondria, endoplasmic reticulum and nucleolus were disappeared. Secretory granules completely disappeared after exposure to 0.14 mg/l. The prolactin cells of long term deltamethrin exposed exhibit signs of hyperactivity, evident by degranulation and increased nuclear volume. No marked histological changes were observed at lower concentration of deltamethrin. At subcellular level decrease in mitochondria number, endoplasmic reticulum and secretory granules was disappeared with higher concentration. Significant changes observed in endocrine gland i.e. Ultimobranchial gland, Corpuscles of Stannius and Prolactin cells at higher concentration of deltamethrin. Intestine, brain and gills were the most affected tissues of the fish. Na^+/K^+ ATPase activity decreased with increasing concentration of deltamethrin in gills> brain> kidney> intestine> muscle. On the other hand Na^+/K^+ ATPase activity of gills significantly increased with the lower concentration. The levels of Na^+ and K^+ decreased maximally in intestine and gills on exposure to 0.14 mg/L but at lower concentration, significant decrease was noted only in intestine. Significant inhibition in the order brain>mus cle>gills>intestine>kidney was noted in Ca^{2+} ATPase activity at higher concentration. However, the enzyme activity was elevated in gills at lower concentration (0.07 mg/L). The level of Ca^{2+} decreased in inte stine>muscle>gills>brain>kidney. At lower concentration significant decrease was observed only in intestine. Mg^{2+} ATPase activity in brain and muscle decreased with higher concentration but increased in the kidney with lower concentration of deltamethrin. The concentration of Mg^{2+} decreased in most of the tissues. At lower concentration significant decrease was observed only in intestine. Na^+/K^+ ATPase, Ca^{2+} ATPase and Mg^{2+} ATPase are the membrane bound enzymes, which serve to concentrate nutrients within the cell to maintain proper level of electrolytes and to maintain correct osmotic pressure of intracellular fluids. Present results show that deltamethrin stress affects the activity of membrane ATPase system blocking the normal distribution of the essential ions into muscle cells. This may cause severe effect on the normal functioning of the muscle. Alteration in ATPase activity reflects change in membrane permeability. The stimulation in Na^+ / K^+ ATPase, Ca^{2+} ATPase and Mg^+ ATPase may be attributed to change in cell metabolism, ionic imbalance or membrane alteration. A marked decrease in the concentration of Na^+, K^+, Ca^{2+} and Mg^{2+} which play a vital role in different enzyme systems and acid-base balance of fish observed in all the vital tissue of fish viz. brain, kidney, gills, muscle and intestine indicate a disturbed ionic balance and complete failure of osmoregulation. It may be probably a consequence of gill and kidney damaged. The deltamethrin induced injuries are apparently of such serious nature that normal mechanisms of regulation are incapable of restoring the ionic balance. Na^+, K^+, Ca^{2+} and Mg^{2+} ions are crucial for maintaining the integrity and stability of gill epithelial cell membrane as well as to the development of action potential in muscle and nerves cells pronounced alternation of tissues and plasma concentration severely affects these processes. It is very interesting to record that the maximum decrease of ions was noticed in intestine. Mg^{2+} plays an important role in both Na^+ and K^+ ion in intestinal cell. Furthermore, intestine sarcolemma has also shown to possess a remarkable ability to bind a considerable amount of calcium it is likely this may be an important source of calcium during calcium pump activity involving calcium activated ATPase. Present study focused that even at sublethal concentration of deltamethrin in water might produce dysfunction of several physiological and biochemical consequences in fish. Further inhibition of ATPase and reduction of major cations, recapitulates disruption in the functional activities of the cell, leading to damaged membrane transport system.