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Pernicious Effects of Synthetic Pyretheroid Pesticides on Juvenile of the Marine Fish *(Oreochromis mossambicus)*

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Abstract. Pollution is the biggest concern nowadays in which aquatic pollution is on top. Many xenobiotic components are responsible for causing the pollution in aquatic ecosystem due to their high toxicity and endurance in the environment. In the present study pernicious effects of synthetic pyretheroid pesticides (Cypermethrin and Lambda-cyhalothrin) on the marine fish *(Oreochromis mossambicus)* was studied. Toxicity of the pesticide on marine organism was estimated by determination of the 24 h LC50. The toxicity tests were performed separately for each pesticide. Data generated from the acute toxicity tests were evaluated using the probit analysis statistical method. After the exposure of fish to the pesticides the LC50 values were estimated which were showing that both the chemicals have lethal effect on the fish. Concentration of pesticide is directly proportional to the mortality rate of the fish. The investigation shows that the pyrethroid pesticides have lethal effects.

Keywords: pesticides, lethal effects, Cypermethrin, lambda-cyhalothrin

Introduction

Approximately 70 percent of the earth surface is covered with water (Ahmad *et al*., 2014). Water bodies have wide range of aquatic life and diverse ecosystem. Different toxic component may enter into the aquatic bodies through various anthropogenic activities (Soomro *et al*., 2011). Among these components the pesticides has adverse effect on the aquatic ecosystem. Pesticides are used to control the pest to enhance the yield of economically important crops (Gul-e-Zehra *et al*., 2016). The extensive and uncontrolled use of pesticides reported by (Bashir *et al*., 2018) and toxic components having large concerns worldwide reported by (Damalas and Eleftherohorinos, 2011). In Pakistan about seventy percent population depends on agriculture and sixty eight percent of industries are agro-based. Major crops of Pakistan are cotton, wheat, paddy, sugarcane besides the fruit and vegetables. Eighty percent of the total pesticides consumed in Pakistan are used for the protection of cotton crop. The organo-phosphates and pyrethroid pesticides are largely used against the cotton crop in Pakistan. The second most important foreign exchange crop is rice, which approximately seventy pests reported by (Salim *et al*., 2001). Due to the unawareness of pesticide application and lacking of data, irresponsible behaviour for the pesticide applications and mishandling may additionally cause the sever toxicities within the environment. (Koizumi *et al*., 2017). In Pakistan the continuous development of industries along the shore line is a major threat of pollution to the marine ecosystem, the pollutant may enter into the aquatic ecosystem from the chemical and agricultural industries (pesticides and fertilizers), sewage disposal, petroleum and oil etc. Indus river along the Sindh coast is the most important source of freshwater and sediments which is provide the most favourable condition to sustain the fauna and flora of Indus delta. The outfall of the Indus river and other tributaries carry agricultural, industrial and domestic wastes (Ahmed, 1997). Runoff from agricultural field having the pesticides enter into the aquatic ecosystem like oceans, rivers and stream and cause serious disturbance within the ecosystem (Gul-e-Zehra *et al*., 2016). This kind of study assure the toxic effects of pesticides. Furthermore, this study reveals about the buildup of those pollutants in non-targeted species (WHO, 2010). In the contemporary world the employment of pesticide is become an integral part because of rising in population, pesticides not only increase yield but also suppress the trans able disease through pests (Pan-Germany, 2012).

Various diseases were also reported in human due to the exposure to pesticides (Mostafalou and Abdollahi, 2012). The bio-accumulation of toxic substances is the risk in aquatic organism as these animals are susceptible to pollutants (Gul-e-Zehra, 2017). Pollution generated

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by pesticides impact the population of fish and shell fisheries, many diseases may cause including epidermal diseases and within the heavy contaminated areas protozoon generated diseases were also reported (Farid *et al*., 2015). The biochemical functions of an aquatic animal is also be affected by the pesticide accumulation in the body (Gul-e-Zehra *et al*., 2016; Gul-e-Zehra and Nafisa, 2016). Some pesticides may additionally effect the swimming, feeding and other responses (Lalamore *et al*., 2016).

Water quality and health of organisms severely stricken by the toxic chemicals were studied the effect of pesticides on the organs of fish *O. mossambicus* and their study reveals the gill are the most sensitive organ to pollutants. Pyrethroid toxicity was also determined by Satyavardhan (2013). The present study correlate with the toxicity levels and the effects on the juvenile of the fish *O. mossambicus*. The LC50 values were determined and data analysis was done to assess the acute toxicity level of pyrethroid pesticides Cypermthrin and Lambda-Cyhalothrin (Gul-e-Zehra *et al*., 2016).

Materials and Methods

Collection of fish. The juveniles of fish *O. mossambicus* (2.7±1 cm length, 5±1 g weight) were collected from chilliya (Thatta). To avoid the stress neat and clean aerated containers were used for transportation. Collated fished transfer into the laboratory for further experimentation.

Acclimatization of fish. The clean *Glass aquaria* of size (92 cm length x 39 cm width x 47 cm height) were used to keep the fish for acclimatization at the laboratory condition for one week. Temperature, salinity and pH were maintained (23 °C±1 °C) 30 ppt and pH 7.5 respectively with photoperiod 16 h of sunshine and 8 h of dark (16 L : 8 D) cycle. The water of every glass aquaria was daily changed so, as to get rid of feces and remaining food particles from the water to keep up the hygiene. Provided oxygen saturated level was 60%. Commercially purchased feed was used for 2 times in an exceedingly day.

Preparation of chemicals. The pyrethroid pesticides (cypermethrin and lambda-cyhalothrin) were purchased from the market (cypermethrin 10% EC, lambda-cyhalothrin 2.5% EC). 100 ppm stock solution was prepared in filtered sea water and by using stock solution working standards were used to expose the fish juvenile for 24 h.

Bioassay. Acute toxicity bioassay was determined for 24 h as per the described method by Gul-e-Zehra *et al*. (2016). Different concentrations ranges from 20-80 ppb were prepared in the natural sea water for the exposure, all the equipment's were priory acid washed to avoid the contamination and disturbance in the results. For the exposure glass aquaria were used (30.5 cm Length x 30.5 cm width x 30.5 cm height). The number of fish in each aquaria were 10. For each concentration triplicates were used against control. In control aquaria clean pure sea water was used. The temperature, salinity and pH were settled as (23 °C±1 °C), 30 ppt, 7.5 respectively. 16 h light and 8 h dark photoperiod was given to the exposed fish. Mortality of organisms were estimated by the action of pesticides after 24 h exposure through LC50 (the concentration where the 50% of exposed organism were died due to the action of pesticide). The LC50 values were determined by using computer program, Biostatic 2009 based on Finney Method (1952) Probit analysis.

Results and Discussion

The present study reveals that synthetic pyrethroid pesticides (Cypermethrin, Lambda-Cyhalothrin) damage the population of the marine fish (*Oreochromis mossambicus*). The rate of mortality (%) was directly proportional to the concentration of pesticides (Figs. 1, 2). The variability in the degree of sensitivity is reflected by the lethal concentration values of pesticides, at which 50% mortality occurs (LC50), shown in Table 1. In the present study we noted that Lambda-Cyhalothrin is the most toxic pesticide having low LC50 than Cypermethrin.

The result of the present study shows that synthetic pyrethroid pesticides have severe toxicity effects on marine fish although LC50 values are very low. The results are related with the study of Gul-e-Zehra *et al*. (2016), reveals that these pesticides cause the serious damage in fish organs and these chemicals also have the potential to accumulate in the fish body, through the food chain these chemicals ultimately transferred to the human. (Cypermethrin, Lambda-cyhalothrin) and suggested a serious apprehension about its potential danger to *O. mossambicus* and subsequently to human beings by food chain. However, *O. mossambicus* is hardy fish and any impact of pesticides would indicate much more impact on other susceptible species. The fish mortality is directly proportional to the concentration of the pesticides (Shoaib and Siddiqui, 2015; 2012). The LC50 values obtained in our study can be compared

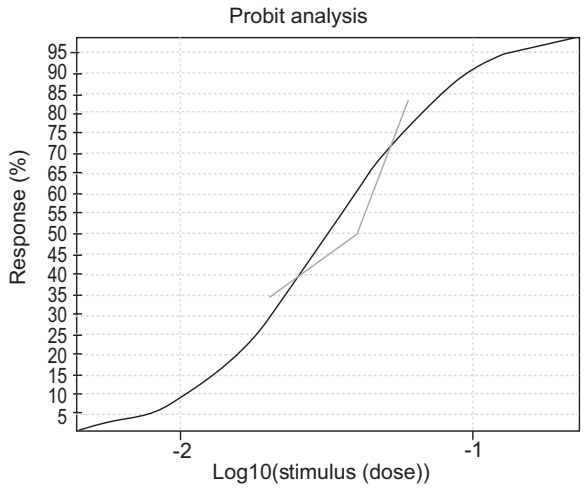

Fig. 1. Probit analysis curve showing the response of marine fish (*Oreochromis mossambicus*) after exposure to different concentration of Cypermethrin pesticide.

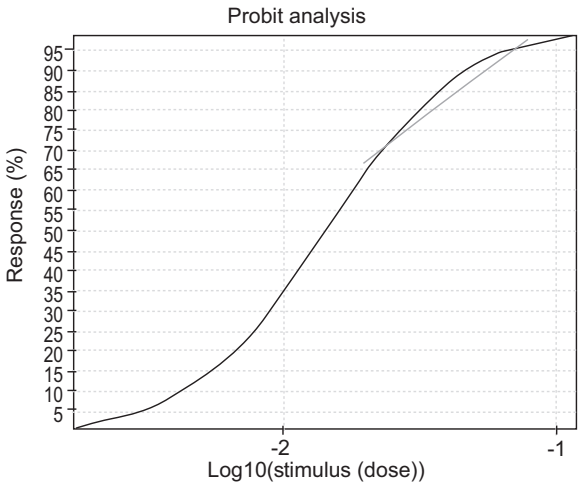

Fig. 2. Probit analysis curve showing the response of marine fish (*Oreochromis mossambicus*) after exposure to different concentration of Lambda-cyhalothrin pesticide.

Table 1. Effects synthetic pyrethroid pesticides on marine fish (*Oreochromis mossambicus*) after 24 h of treatment showing LC50

Pesticides	No. of fishes	Concentration tested (ppb)	LC50 ppm	Intercept	χ-square	P-level
Cypermethrin	150	20-80	0.031	9.01	0.342	0.56
Lambda-cyhalothrin	150	20-80	0.014	9.62	0.037	0.98

with those reported earlier for fish (Dey and Saha, 2014; Ilyas and Javed, 2013). Despite the fact that synthetic pyrethroid pesticides may exist in the environment for very short time but their toxicity is very high (Deb and Das, 2013). Therefore synthetic pyrethroid pesticides can damage the organism in a very short period of time. Present study reveals that the Lambda-cyhalothrin is more toxic than cypermethrin pesticide having LC50 0.014 ppm reported that the Lambda-cyhalothrin pesticide is more toxic to mosquito fish having LC50 0.0022 ppm. The synthetic pyrethroid pesticides may cause the functional disorders of many organs like neurological, respiratory dysfunctions which leads to the suffocation and ultimately cause death (Banae *et al*., 2011). However, the present study shows the value from 0.014 ppm to 0.031 ppm which are the low values of LC50. Many severe physiological disorders are also investigated in the fish due to the effects of pesticides (Banaee *et al*., 2009).

Fish is an important source of protein, any type of contamination including pesticide induction may lead to disturbed their protein level which is investigated by many scientists (Korkmaz *et al*., 2009). Blood circulation is very fast in the fish gill so the any type of contaminant are rapidly absorb by the fish gills. Fish is the major source of protein in the population. Any type of disturbance in metabolism of the fish body may lead to cause the sever disturbance in fish protein as a result of which fish cannot full fill the protein demand, this may also cause the economical disturbance in fish industry. In the light of the researches we can say that pesticides have the adverse effect on the marine life through bio-accumulation in the body, these toxicity directly or indirectly harm the food web of our ecosystem (Abedi *et al*., 2013). Table 2 is representing the pesticides and its effects on the marine life.

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Table 2. Effect of pesticides on fish species showing lethal concentration LC50

Pesticides	Fish species	LC50 ppb	References
Chlorpyrifos	*Oreochromis mossambicus*	63	Gul-e-Zahra *et al*. (2016)
Malathion	*Oreochromis mossambicus*	28	Gul-e-Zahra *et al*. (2016)
Lamda-cyhalothrin	*Labeo rohita*	0.7	Dey and saha (2014)
Dimethoate	*Labeo rohita*	24.55	Dey and saha (2014)
Endosulfan	*Catla catla*	2.15	Ilyas and Javed (2013)
Endosulfan	*Cirrhinus mirigala*	1.06	Ilyas and Javed (2013)
Fenvalerate	*Aphanius disper*	16.5	Shoaib and Siddiqui (2015)
Fenpropathrin	*Aphanius disper*	1.4	Shoaib and Siddiqui (2015)
chlorpyrifos	*Aphanius disper*	2.5	Shoaib *et al*. (2012)
Methyl parathion	*Aphanius disper*	39	Shoaib *et al*. (2012)

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Conflict of Interest. The authors declare no conflict of interest.

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