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Channa punctata (Bloch, 1793) As A Model For Toxicological Studies

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Abstract:
Environmental pollution due to widespread usage of pesticides, without appropriate management, results in survival threat to aquatic animals, especially fish. Some of them may cause physiological damage. *Channa punctata* is used as a model in several pollution studies because of its availability and suitability. In present investigation an attempt is made to evaluate the toxicity of a pesticide Applaud which is an insect growth regulator used in agricultural practices for the biological control of insect.

Keywords: snakehead, pesticide, insect growth regulator, lethal concentration and toxicity.

Introduction:

Freshwater aquaculture is important in many aspects like food, employment, economy and living standard of the people associated with it. India is second-largest contributor to global aquaculture production. Freshwater aquaculture has important role in Indian economy as it help to improve the nutritional level of rural people. Murrels (snakehead) and catfishes are economically important species having great potential for aquaculture and capture fisheries throughout southern and southeastern Asia (Haniffa 2009). The Asian genus *Channa*, has 26 valid species, is distributed in Iran and southern Asia (the Indian subcontinent), South Eastern Asia (Thailand, Laos, Cambodia, Vietnam, Malaysia, Indonesia and Philippines) China, Taiwan, Korea and Southern Russia (Li *et al.* 2006; Nguyen *et al.* 2008; Vishwanath and Geetakumari 2009) Afghanistan, Pakistan, India, Nepal, Sri Lanka, Bangladesh, and Myanmar (IUCN 2014).

The spotted snakehead is common throughout the plains of India and Pakistan. Snakeheads or murrels are well known air brething freshwater fishes, family Channidae. The Asian genus *Channa*, has near about 26 species. They are widely distributed in Iran and southern Asia (the Indian subcontinent), South Eastern Asia (Laos, Malaysia, Cambodia, Thailand, Vietnam, Indonesia and Philippines) and the far East (Korea, China, Taiwan, and Southern Russia) (Li *et al.* 2006; Vishwanath and Geetakumari 2009).

Channa gachua can be used for the biological control of mosquito in larval stage ultimately helps to control the diseases spread by mosquitos (Phukon and Biswas 2011). Recently Vishwanath and Geetakumari (2009) reported that North Eastern India is an important denizen for about nine species of *Channa*. Taxonomy and phylogeny of these species has been studied (Lakra *et al.* 2010). Eight species belonging to genus *Channa* (*C. striata, C. punctata, C. marulius, C. gachua, C. stewartii, C. urantimaculata, C. barcaand* and *C. bleheri*) are found all over India. All these species are economically as well as medicinally important and available in ample amount in the freshwater resources of India (Jayaram 1999), including ponds, lakes, reservoirs canals and dams (Nguyen *et al.* 2008). *C. striata, C. punctatus, C. marulius and C. gachua* are found in freshwater resources of eastern Vidarbha abundantly of these, *C. punctata* is selected for present study. It is least concern as per IUCN red list of threatened species database (IUCN 2014).

Materials:

Applaud:

Pesticide Applaud, an insect growth regulator used in the present study has a major constituent Buprofezin. This product is sold by various national companies with different names. It is manufactured by Tata Rallies Industries Pvt. Ltd., India. It is not highly toxic hence it is suitable for experimental set up.

Insecticide Applaud comes under the inhibitors of chitin biosynthesis type III (WHO 2010), slightly hazardous (The Globally Harmonized System of Classification and Labelling of Chemicals, GHS Category-5) with CAS no 69327-76-0, and LD_{50} 2200 mg/kg body weight (GHS 2009).

Its mode of action is quite different as it does not kill the insect pest. It is used for integrated and biological pest management in agriculture. Acute toxicity of Applaud is calculated by probit analysis with software SPSS after exposure.

Properties of pesticide Applaud:

Major Composition: Buprofezin

Pronunciation: bū-prō-*fē*-zĭn

Chemical name: 2-tert-butylimino-3-isopropyl-5-phenyl-1, 3, 5-thiadiazinan-4-one

Empirical formula: $C_{16}H_{23}N_3OS$

Molecular weight: 305.4

Solubility: Buprofezin has a solubility of 0.38 mg/l.

Experimental Fish:

Present study was carried out with freshwater fish *C. punctata* (Bloch, 1793). It is selected for the present study due to its availability and air breathing ability. Adult fishes (weight, 124 ± 2.11 and length 21 ± 0.16 cm) were collected from the local freshwater resources.

Method:

Fishes were brought from local freshwater resources and maintained at the laboratory conditions for a week. Experiment was carried out by following guidelines of Institutional Animal Ethical Committee in agreement of Committee for the purpose of control and supervision of experiment on animals (CPCSEA), Ministry of Environment and Forests and APHA (APHA 2005).

Experimental Design

Fishes were sorted on the basis of morphological observations to check whether they are infected or diseased. Healthy fishes were selected.

Two fish groups (control and experimental) each with ten fishes were used in analysis of toxicity for a period of 24 h, 48 h, 72 h and 96 h. Fishes were kept in tanks with well aerated and filtered de-chlorinated fresh water with a static condition and natural photoperiod. They were fed twice daily with commercial fish pellets containing rice bran, mustard cake, fish meal, groundnut cake and soybean meal as major ingredients. Pesticide solution was replaced regularly after 24 h (in case of 48 h, 72 h and 96 h LC_{50} calculation) with the freshly prepared solution of pesticide with respective concentration of toxicant.

Calculation of LC_{50}

LC_{50} was calculated by following guidelines of APHA (APHA 2005). After acclimatization, fishes were divided into groups containing 8 fishes in each group. These groups were then exposed to pesticide Applaud at different concentrations simultaneously with one group as a control group. LC_{50} was calculated with probit analysis (Finney and Stevens 1948) by using SPSS software.

Result and Discussion:

LC_{50} of Applaud for 24h, 48h, 72h and 96h exposure is found to be 459.29, 326.12, 253.30 and 198.84 ppm respectively (Table 1). Its comparative toxicity representation is shown in Figure 1. This has been calculated on the basis of mortality of fishes in respective time duration in each group. LC_{50} for 24h was highest 459.29 ppm while LC_{50} for 96h is lowest at 198.84 ppm. No mortality is recorded in control groups. Pesticide toxicity variant level in *C. punctata* has been reported at 24, 48, 72 and 96 h (Table 2). Toxicity of pesticide is higher in short exposure time and lowers as exposure time increases. Fenvalerate another pesticide is very toxic to freshwater fishes when dissolved in water as compared to Applaud. Its toxicity is even seen in hardy air breathing fishes for long duration (Datta and Kaviraj 2003). In other practices piscicides Oleandrin is used for removal of unwanted fishes from the ponds. Its toxicity has been studied by using *C. punctata* (Tiwari and Singh 2004). Cypermethrin and λ-cyhalothrin toxicity is also studied with *C. punctata* as a model (Kumar *et al.* 2007). In a study it is found that Endosulfan is highly toxic than Malathion and Carbaryl (Naosekpam and Gupta 2013). (Tripathi *et al.* 2003). Chlorantraniliprole has 14.424mg/L LC_{50} for 96h (Bantu and Vakita, 2013). Tripathi *et al.* reported 17.92 mg/L LC_{50} for 24h for Dimethoate. Similarly LC_{50} for 96h of Monocrotophos is 18.6 mg/L (Agrahari *et al.* 2007) and Endosulfan has 24.3 µg/L (Sarma *et al.* 2010). Chlorpyrifos is highly toxic to fish (LC_{50} for 24h 5.38 µl/L) and affects their survival (Mishra and Devi 2014). At very lower concentration Cypermethrin (LC_{50} for 96 h is 0.00078 µl/L) could affect the physiology of fish (Tantarpale and Rathod 2014).

Mortality of embryo and larvae is increases with the increases in concentration of Buprofezin has been studied in African Catfish, *Clarias gariepinus* (Bloch). The 24 h and 48 h LC_{50} values (with 95% confidence limits) for its larvae were assessed to be 5.71 mg/L and 4.64 mg/L respectively (Marimuthu *et al.* 2013).

Table 1: Median lethal concentration (LC_{50}) of Applaud at 24, 48, 72 and 96 h with 95% confidence limits

Exposure period (h)	LC_{50}	Chi square[a]	Sig [b]
24	459.29	2.43	0.93
48	326.12	2.82	0.90
72	253.30	3.27	0.86
96	198.84	2.35	0.94

[a] Pearson Goodness-of-Fit Test, [b] Since the significance level is greater than .150, hence no heterogeneity factor is used in the calculation of confidence limits.

Table 2: Toxicity of different pesticide in fish *C. punctata*

Pesticide	Toxicity				Reference
	24 h	48 h	72 h	96 h	
Buprofezin	5.71 (3.198-8.898) mg/L	4.64 (3.264-6.287) mg/L	--	--	(Marimuthu *et al.* 2013)
Fenvalerate	3.50 µg/L (3.14–4.21)	3.33 µg/L (2.8–3.9)	3.12 µg/L (2.72–3.57)	2.93 µg/L (2.45–3.49)	(Datta and Kaviraj 2003)
Oleandrin	2.64 mg/L	2.51 mg/L	2.65 mg/L	2.38 mg/L	(Tiwari and Singh 2004)
Cypermethrin	--	--	--	0.4 mg/L	(Kumar *et al.* 2007)
λ-cyhalothrin	--	--	--	7.92 µg/L	
Endosulfan	18.2 µg/L	2.5 µg/L	1.1 µg/L	0.7 µg/L	(Naosekpam and Gupta 2013)
Malathion	5.5 mg/L	2.3 mg/L	1.6 mg/L	0.9 mg/L	
Carbaryl	10.9 mg/L	8.3 mg/L	8 mg/L	7.5 mg/L	
Chlorantraniliprole	--	--	--	14.424mg/L	(Bantu and Vakita 2013)
Dimethoate	17.92 mg/L	--	--	--	(Tripathi *et al.* 2003)
Monocrotophos	--	--	--	18.6 mg/L	(Agrahari *et al.* 2007)
Endosulfan	--	--	--	24.3 µg/L	(Sarma *et al.* 2010)
Chlorpyrifos	5.38 µl/L	--	--	--	(Mishra and Devi 2014)
Cypermethrin	--	--	--	0.00078 µl/L	(Tantarpale and Rathod 2014)

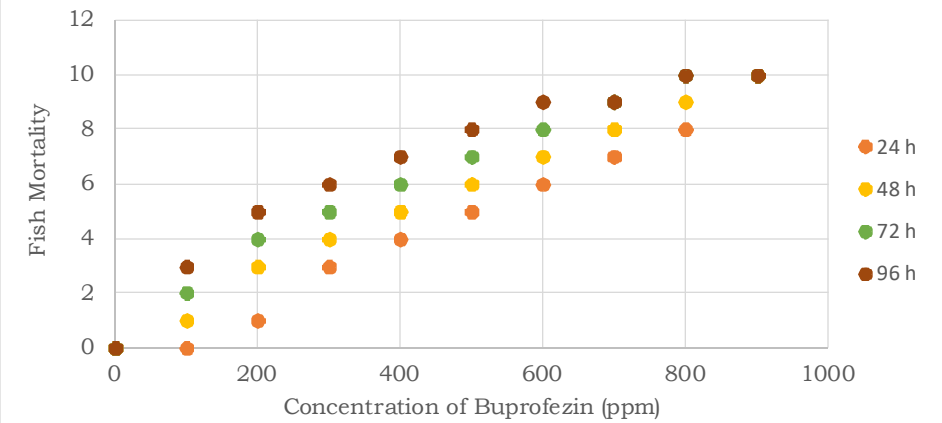

Figure 1: Comparative toxicity representation of Applaud at 24, 48, 72 and 96 h.

Conclusion:

The toxicity level of pesticide Applaud decreases with exposure period. It can be used for toxicological study in *C. punctata* for longer duration so as to make assumptions, exploration and sustainable management strategy related to other ichthyofaunal diversity. Present study represents the baseline data for toxicity of Applaud to *C. punctata*. It is less toxic as compared to previously recorded data of different pesticides. Applaud can therefore be preferred for integrated and biological pest management practices in agriculture.

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Conflict of Interests:

The authors declare that there is no conflict of interests regarding the publication of this work.

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