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Neurobehavioral Changes in Freshwater Fish *Channa punctatus* Exposed to Fenitrothion

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Recently a vast number of pesticides have been liberally used in agriculture to combat the pest menace to procure the higher yield from the crops. These pesticides indiscriminately affect the nontarget organisms such as fishes and prawns which are of great economic significance to common man (Butler 1965).

Fenitrothion is an organophosphate pesticide extensively used in agriculture for crop protection. Fenitrothion has induced remarkable changes in the tissues of exposed fishes followed by depletion of succinate dehydrogenase and increase of lactate dehydrogenase activity (Koundiya and Ramamurthi 1978). Neurotransmitters such as acetylcholine (Ach) catecholamine 5-hydroxytryptamine (5-HT) and aminoacids are closely associated with functional activities in the central nervous system (Goodman et al. 1980).

MATERIALS AND METHODS

Channa punctatus (Bloch) 10-15 gm were collected from local resources and acclimated to standard laboratory conditions(Gopal and Mishra, 1988). Toxicity tests were conducted in wide mouthed jars containing 20 L of tapwater with following characteristics: temperature 26±2°C, pH 6.9-7.2, alkalinity 95-100 gm/L as $CaCO_3$ and hardness 118-122 mg/L as $CaCO_3$.

Fenitrothion dissolved in alcohol was added to water containing test fishes to attain the desired concentration (0.4 mg/L) for 96 hr. Parallel group of control fish was also maintained under identical conditions.

Brains of 5 fish from treated as well as control were removed quickly and deep frozen at (0°C). Parts of the brains were dissected out into 3 regions on ice cold glass plate and homogenized in N-butanol. Norepinephrine (NE), Dopamine (DA) were extracted in 0.1 M phosphate buffer and 5-hydroxytryptamine (5-HT) in heptane. Fluoroscence of NE was measured at 385

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nm activation/485 nm emission. Just after 20 min DA was measured at 320 nm activation/385 nm emission and 5-HT measured at 360 nm activation/470 nm emission (Jacobowitz and Rechardson 1978). Convert fluoroscence reading into μg NE, DA or 5-HT per/g of tissues. 82% recovery was observed. Data was analysed by student's t test.

RESULTS AND DISCUSSION

Fish exposed to (0.4 mg/L) fenitrothion for 96 hr showed a significant ($P < 0.001$) increase in NE level in cerebellum followed by significant ($P<0.001$) decrease in medulla and cortex. Exposed fish for 96 hr showed a significant ($P<0.001$) increase in DA level in cerebellum and significant decrease ($P<0.001$) in medulla and cortex. Significant decrease ($P<0.05$) in 5-HT level in medulla and cortex ($P<0.001$) was observed.

Table 1. Norepinephrine, Dopamine and 5-Hydroxytryptamine (μg/g fresh tissue weight) in brains of Channa punctatus exposed to fenitrothion. n = 6

Neurotransmitter	Exposure	Cerebellum	Medulla	Cortex
Norepinephrine (NE)	Control	0.14±0.01*	1.63±0.02	0.14±0.02
	Fenitrothion (0.4 mg/L)	0.21±0.01[b]	0.09±0.003[b]	0.05±0.001[b]
Dopamine (DA)	Control	0.20±0.01	0.33±0.01	0.11.0.01
	Fenitrothion (0.4 mg/L)	0.57±0.02[b]	0.10±0.02[b]	0.05±0.002[b]
5-Hydroxytryptamine (5-HT)	Control	0.38±0.01	0.42±0.04	0.49±0.01
	Fenitrothion (0.4 mg/L)	1.39±0.30	0.37±0.01[a]	0.33±0.03[b]

Each value represents the mean ± S.E.M. for 6 observations.
* a $P<0.05$; b $P<0.001$ (Student's t test)

Neurobehavioral changes were also observed which exhibited by surfacing, distance travelled, jumping, erratic movements, convulsions and opercular movements. Exposed fish showed enhanced surfacing activity under stress conditions of fenitrothion. It is assumed that the pesticide severely reduces the capacity of free swimming and physical stamina of gills, accompanied by structural lesions (Mandal and Kulshrestha 1980). Orientation and locomotor patterns were found to be involved in most aspects of fish behavior such as migration, mating, courtship and feeding, which were altered under stress conditions of environmental toxicants (Kleerkoper 1976; Steel 1983). Depletion of 5-HT in fenitrothion exposed fish showed involvement of serotonergic system with physiological and

behavioral alterations. The depletion of 5-HT in brain of freshwater fish was reported during pesticide stress (Gopal et al. 1985). Husain et al. (1987) have observed increase in 5-HT level in corpus striatum, cerebral cortex and midbrain. Significant increase of DA in ponsmedulla and decrease in corpus striatum as well as in cerebellum were noticed. Fingerman and Russell (1980) reported the depletion of NE and DA in Aroclor 1242 exposed fish, followed by enhancement of locomotor activity. Involvement of catecholamines in the central regulation of motor activity motivated the emotional and aggressive behavior and sensory perceptions in neonatal rats (Gotter and Michaelson 1975; Crow, 1977).

Involvement of DA has been implicated in neurotoxicity of pesticides in fishes and other vertebrates (McDonald 1979). It is reported that epinephrine (EP) and NE directly introduced into the brain causes central nervous system depression (Crossland 1980). Catecholamines (CA) and 5-HT in the brain have been involved in the etiology of depression (Borsini 1981).

It is suggested that fenitrothion induced alterations in NE, DA and 5-HT levels in certain parts of brain may be due to their enhanced turnover rates or impairment of their active transport.

Authors concluded that neurobehavioral changes and signs of the pesticide stress in the form of rapid swimming, enhanced rate of opercular movements, convulsions, tremors and surfacing activity may be useful for the biological assessment of pesticide toxicity in aquatic systems.

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