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BEHAVIOURAL STUDY OF TWO TOXICANT ON FRESH WATER FEMALE CRAB *BARYTELPHUSA GUERINI*

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ABSTRACT

When an organism is exposed to any toxic agent, some changes occur in the behaviour which can be observed externally. These behavioural changes may be co-related to the changes occurring in the nervous system, as different behavioural responses are sub-served wholly or partly be the different neural circuits which are distributed in the nervous system. Behaviour includes all those process by which an animal senses the external world and internal state of its body, and responds to changes which it perceives. Many of such processes will take place inside the nervous system and may not be directly observed but reflected through the behaviour of the animal. When a toxic compound is administered, some changes occur from the normal behaviour, and they can be observed externally. These behavioural changes would be caused by the changes in the nervous system caused directly or through metabolic or physiological activities. It is know that insecticides have profound physiological and biochemical effects on crustaceans, the magnitude of which varies with the concentration and duration of exposure. The behaviour of crab is an index of its physiological status and any change in its behaviour indicates a change in physiological activities and vice-versa.
In this work two different type of pesticides like Organochlorine and Organophosphates under stress change the Behavioural activity which is under observation discussed.

KEYWORDS: *Behaviour, Toxicant, Freshwater, Barytelphusa Guerini*.

INTRODUCTION

The behaviour of control crabs throughout the period of observation was normal in the sense that they are alert and active; their locomotory movements are well coordinated and scuttle fast even at the slightest disturbance indicating an escape reaction. When approached too closely, they exhibited an offensive posture by standing on their walking legs and lifting the chelate legs in a threatening way.

Experiments on Fiddler crabs (Arechiga *et al.,* 1974) and Slugs (Ramamurthi and Sainathjanak, 1973) have demonstrated a good correlation between physiological activities, metabolic changes and behaviour of these animals. Leake (1977) reported an interesting correlation between poisoning symptoms and aberrant electrical activity in the central neurons of the leech, *Hirudo medicinalis*, during S-bioallethrin poisoning. Behavioural responses involve the most complex processes of sensory input, central processing and motor output point to neurotransmitter systems, as key components of these molecular events. In recent times, increasing attention has been paid to the neurotransmitter systems and their role in the behaviour of intact organisms as they react to and manipulate their external physical and social environment.

Behavioural toxicology has assumed a key place of increasing importance in evaluation of toxic compounds which affect not only target animals but also non-target animals, as it confirms the potentiality of the compound and also the tolerance limit of the animals. It was reported that alterations in the chemical composition of the natural aquatic environment usually affects the behavioural and physiological system of the inhabitants.

The first step in collecting information on the site and mode of action of insecticides is the categorization of poisoning symptoms. It was found that there are two types or classes of pyrethroids based on the symptoms produced. The type-I poisoning Syndrome or 'T' syndrome is characterized by restlessness, in coordination, prostration and paralysis in cockroach (Gammon *et al.,* 1981) and aggressive sparring

behaviour, elevated startle response, whole body tremors and prostration in the rat (Verschoyle and Alridge, 1980). Type II poisoning syndrome or 'CS' Syndrome is characterized by in coordination, convulsions and intense hyperactivity in cockroach (Gammon *et al.*, 1981), where as in rats, burrowing behaviour, tremors, clonic seizures and profuse salivation without lacrimation (Verschoyle and Aldridge, 1980) are observed.

OBSERVATIONS

Symptoms Observed

Behavioural changes were noted time to time in different groups of animals exposed to different pesticidal pollutant. The acute toxicity has been studied with endosulfan and dimethoate with various concentrations.

1) Study of Behavioural Acute Toxicity with Endosulfan

As shown in indicators acute toxicity data with different concentration of endosulfan solution to which the animals *Barytelphusa guerini*, a freshwater female crab were exposed, observed behavioural symptoms from eleven response of groups were noted.

Response of Group No.1

The first group serve as control in which crabs, *Barytelphusa guerini* were exposed in tap water. The animals has been showed normal activity upto the end of experimental set. The crabs were healthy and showed normal activity upto 96 hours.

Response of Group No.2 and No.3

After 24 hrs. of exposure time the animals exhibited following symptoms. The animals seem to be uneasy with their activity. They showed immediate activity and more movements. Response to pollutant to avoid the contact of water, they stand one upon one at the corner of aquarium.The mortality was not observed in response group no.2. The mortality observed in response group no.3 was 10% within 96 hrs.

Response Group No.4 and No.5

In this response group the concentration of endosulfan show distinct behavioural changes like increase in respiratory metabolism, active movement of chelate legs. They were always in the attacking position. The animal show higher excretion. Rate of feeding decreased due to sensitivity of pesticide pollutant endosulfan. The mortality of response group no.4 was 20% and mortality of group no.5 was 30% mortality and behavioural response against pollutant increased in the group no.2 and no.3.

Response Group No.6 and No.7

The important symptoms were noted as high activity of animals, fast movement of chelate legs. These groups showed feeding it normal and locomotion was not normal. The activity of mouth parts was fast, bubbles were released in water with small sound. The mortality of group no.6 was 40% and response group no.7 was 60% within 96h LC_{50} was in between group no.6 and group no.7.

Response Group No.8 and No.9

The symptoms observed in these groups were hyper activity of respiration. Anterior and ventral surface was with air bubbles. Excretion rate was also increased with pronounced movements of legs.Animals became sluggish and violent, colour changes yellowish to dark. Increase in concentration media all these symptoms were observed. The mortality recorded 70% and 80% within 96 hrs.

Response Group No.10 and No.11

In these groups animal showed hyper excitation, loss of locomotion and decrease in expire of oxygen. The animals became sluggish and inactive. The mortality recorded in these groups are 90% and 100%. The mortality was high at 48h, 72h and 96 hours.

2) Study of Behavioural Acute Toxicity with Dimethoate

As indicates acute toxicity data with different concentration of dimethoate solution to which the animals *Barytelphusa guerini*, a freshwater female crab were exposed. Observed behavioural symptoms from eleven response of groups were noted.

Response Group No.1 (Control)

In this group freshwater female crab *Barytelphusa guerini* were exposed in regular tap water which serve as control. All the animals were showed normal activity within 96 hours.

Response Group No.2 and No.3

Symptoms exhibited by animals in these groups were recorded, after one hour exposure time, the animals became active, increase in respiratory metabolism and active movement of chelate legs for biting. Mortality was seen in group No.2, 10% in group No.2, 20% within 96 hours.

Response Group No.4 and No.5

Hyper excitability increase in rate of oxygen consumption which is followed by exclusion of air bubbles through gills and increase in mucus secretion is seen around the mouth area. Mortality were recorded in these groups was 30% within 96 hours.

Response Group No.6 and No.7

As the exposed animals became with slight noise movement sheart but after long exposure time upto 96 hours and increase in concentration of media animals showed progressive decrease in respiration and upward movement of their chelate legs. Animals became sluggish and violent and there was change as colour of ventral side that become dark instead of yellowish all these symptoms were observed within some hour. This group shows 50% and 60% mortality. LC_{50} was in between in group no.6 and no.7.

Response Group No.8 to No.11

Symptoms recorded in these groups were similar to the symptoms observed in group no.7. It shows hyper excitability loss of locomotion and decrease in exhalation. The mortality recorded in these group were 70%, 80%, 90% and 100% respectively within 96 hours.

RESULT

The female crabs *Barytelphusa guerini* showed very quick & notable response against endosulfan & dimethoate. Crab exposed to lethal concentration of endosulfan & dimethoate settled at the bottom of the trough. The locomotory activity was disturbed water media in the first day itself. Crab occupied larger area than to that of control group. Irregular, erratic and darting movements with imbalanced activity and attempt to jump out of the toxic medium observed.

Crab in non-toxic media showed full covering of the trough during the first two days. No other notable behaviour was observed in control. The detail observations are given in Table .1.

Table 1: Observation made during lethal concentration exposure of freshwater female crab *Barytelphusa guerini.*

Observations	Endosulfan	Dimethoate
Response against pollutant	In endosulfan crabs show immediate excitation. Try to move come out of aquarium.	In Dimethoate crabs show excitated activity. These are move to corners of container & try to avoid toxicant by climbing on one another.
Activity of mouth parts	Quick and continuous movement of mouth parts, before 24h, but after 24h activity slow down. Bubbles out the air with a sound.	Mouth parts showed movement continuous washing chelae within 24h, but after 24h mouth deeped in water media. Bubbles out the air.
Activity of eye lead	Crabs exposed in Endosulfan eye stalk always exciated movement but after two days they always closed. They open eyes slowly by striking any disturbance.	Eyes always in fast movement. Within 24h their movement fast as compare to 48h & 72h. There eyes easy open by striking any disturbance.
Activity of chelate legs	Chelate legs always upward position, after 48h they slow down, not in excited mode.	Chelate activity in dimethoate same in Endosulfan these are very loosely at 96h.
Position of crabs in aquarium	When crabs exposed in endosulfan they scattered from one another. After 48h they gathered / come in groups. These died at the middle part of aquarium.	When crabs exposed in dimethoate, first position fast movement through out aquarium. Second position they form clamping grop. They died at the point where they stay.
Locomotary Activity	Uneasy normal position later, became abnormal in Locomotion.	Moved constantly and tried to sit at edges with back legs lifted on sides.
Balance equillibrium and coordination	Almost total loss of coordination in first few hours only. It was high at 72 & 96h.	High concentration crabs lost balance collapsed and died in down position. After 24h show loss of balance and un-coordination action.
Attacking excitement	In endosulfan crabs attacking excitement within 24h. After 48h there attacking excitement slow down. After 48h crabs show imbalanced attacking.	In dimethoate crabs attacking excitement very fast within 48h. After 72h excitement low. At 96h crabs show unbalanced attacking.
Offence and defence	Offensive but after few hours could not attack due to un-coordinated movement	Offensive and attacked approaching object, high concentration crabs in 72 hrs. sluggish but offensive.
Food & Feeding	In endosulfan crabs take very fast food within 36 hrs. feeding slow after 48 hrs.	In dimethoate crabs take fast food upto 48 hrs. feeding slow after 72 hrs.

DISCUSSION

Organochlorine insecticides are neurotoxicant, which act directly on excitable membranes and thereby interfere with membrane ionic conductance in target organisms. In the present report irregular movements and impairment of locomotion and weak response to external stimuli and final paralysis. Some of the effects observed which are indicative of the influence of endosulfan on nervous system (Khanna *et al.*, 1979).

In the present study a progressive deteriorated feeding response was observed in the crab *Barytelphusa guerini* during endosulfan intoxication. Bhagyalakshmi *et al.*, (1984) reported ineffective feeding and un-coordinated movements in field crab *O. senex senex* expoed to sumition. This reflects the effects of Ach accumulation at nerve endings, thus disrupting the synaptic transmission of nerve impulses from one neuron to another. A decreased intake of food in the fish, *C. carpio* to methyl parathion intoxication was reported by Nagarathnamma (1982) and in the field mouse, *Mus booduga* to BHC treatment (Harold Philip, 1984). The morphological and

behavioural changes exhibited by the crab can taken as useful parameter in assessing the extent of pollution caused by pesticides, because the crab serves as a bio-indicator of aquatic pollution.

Control crabs behaved normally in the sense that they are very active and the movements are well coordinated. They are alert and at the slightest possible disturbance scuttle fast indicating an escape reaction. They exhibited a tendency to retreat when human finger was brought close to them. They react aggressively by extending lifting the chelate legs.

On exposure of under sublethal concentration the crabs responded snapping of mandibular and regurgitating of the mouth was observed. Limb movement was arrested after sometime and the animal reached a state of flaccid pralysis. Locking of the pedipalps with one another and elevated posture on the tips of walking legs was also observed.

Behavioural pathological symptoms were more pronounced and severe upon exposure of the crabs to lethal concentrations of dimethoate. As soon as the crabs were exposed to lethal concentrations of dimethoate, the animals exhibits restlessness for some time which was followed by impaired locomotion. During lethal exposure, feeding, response also deteriorated progressively. The crabs were not inclined to take food. Weak response to external stimuli like disturbances including, touch and pricking was also noticed. After that the crabs gradually fell into a state of lethargy. The behavioural symptoms which are observed in *Barytelphusa guerini* to dimethoate intoxication.

The high excitability shown by virgorous movement of chelae cleaning movements, movements of walking legs and loss of equilibrium and co-ordination are in accordance with previous reports in different fishes as organophosphate and organochlorine pesticide exposed fish (Singh & Shrivastava, 1982) and crustaceans as organophosphate exposed prawn, *Macrobranchium lamerrii* (Sarojini and Gyannath, 1983) organochlorine exposed prawns, M. Kistnensis (Pawar and Katdhare, 1983) phosphomidon exposed shrimps, *M. malcolmsonii* (Reddy *et al.*, 1985). Heavy metal exposed *Paratelphusa jacquemontii* (Thankar, 1985), *Barytelphusa guerini* (More, 1993; Khan *et al.*, 2000; Tamloorkar, 2002).

Behavioural changes observd in the present study in the crab can be taken as useful parameters in formulating safe concentration levels of endosulfan and dimethoate to crab to ensure proper protection of crab and other aquatic recourses.

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