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THE EFFECT OF ORGANOCHLORINE (ENDOSULFAN) AND ORGANOPHOSPHATE (DIMETHOATE) ONHEART BEAT RATE OF FEMALE CRAB *BARYTELPHUSA GUERINI*: A COMPARATIVE STUDY

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ABSTRACT

The animals required food & oxygen continuously for energy and to perform various metabolic activities. Thus digested food and oxygen should be transported to all the cells. This function is carried out with the help of body fluids. The arthropods possess the open type ofcirculatory system, which is presumably derived from the highly organized closed system of their annelids or pre-annelids ancestors. In most of the crustaceans the heart is dorsally placed inside the body. The blood fills up to the main body cavity. Which does not corresponds to a primitive coelomicspace but to sinuses of cavities burrowed within the body tissues. Thus tissues are in direct contact with blood. In these animals the system of cavities should be considered as a haemocoel and theblood which fulfils the characters of a circulatory fluid and those of inertial lymph should be caused haemolymph. The pigment haemocyanin is found in the blood of most crustaceans hence it has light blue colour. The green resolution has increased the production utilization of various types of pesticides for increasing the agricultural productivity; the indiscriminate use of them has polluted the aquatic environment, because these pesticides ultimately find the way aquatic environment. These pesticides have been found to be extremely toxic not only to several aquatic biota including crustaceans (Reddy & Rao, 1986) and ultimately poisoning dual threat to mankind. Pollution of aquatic environment by a variety of toxic substances has been a major concern for humanity Present research work on comparatively study of effect of organochlorine and Organophosphate pesticides on heartbeat of fresh water female crab Barytelphusa guerini, which is discussed with result statically and graphically.

KEYWORDS: Organochlorine, Organophosphate, Heart Beat, Barytelphusa guerini, Comparative Study.

INTRODUCTION

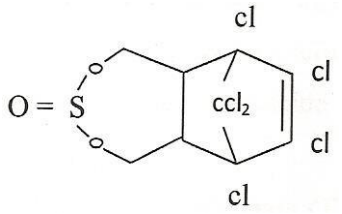
The chlorinated hydrocarbons are basically organic compounds that have been chlorinated with several atoms of chlorine per molecule. These insecticides have very low solubility in water but are readily soluble in fats (Abbot *et al.,* 1968). These compounds are chemically stable and show considerable persistence upon introduction into physical environment. Since these compounds are stable and persistent, they are referred to as "hard pesticides" (Abbot *et al.,* 1966). Some examples of these pesticides are DDT, Lindane, Heptachlor, Mirex, Chlordane, Aldrin, Methoxychlor, Dieldrin, endosulfan, Toxaphene etc. These compounds exhibit biological magnification in the food chain (Macek, 1969).

Available evidence suggests that organochlorine insecticides have an inhibitory effect on ATP ase associated with oxidative phosphorylation. The significance of ATP ^{ase} in controlling high energy metabolic transformation and ion movements in living tissues has been extensively reviewed (Yamazaki, 1977). Inhibition of ATP ^{ase} leads to disruption of ion movements across the nerve cell membrane (Murphy, 1980) and interferes with normal passage of the nerve impulses in the nerve fibers (Cutkomp *et al.,* 1982). Chlorinated hydrocarbon nerve poisons are one of the most important insecticide groups used today. Chemically they are relatively unreactive stable compounds and are characterized by their long lasting residual effects. Chlorinated hydrocarbon insecticides owe their biological activity mainly to their ability to upset the nervous system of living organisms, though some side–effects (such as effects on biological oxidation system) have been noted in other parts of the body (Fumio Matsumura, 1985).

Endosulfan

Endosulfan (6, 7,8,10, hexachloro–1–5, 5a, 6, 9,9a, –hexahydro–6, 9–methano–2, 4, 3–-benzodioxathiepine–3–oxide) is a broad spectrum cyclodiene compound. It was introduced in 1956 by „Hoechst A.G." under the code number „Hoe 2671" with the trade name „Thiodan".

It is a brownishcrystalline solid with a setting point of 70 – 100□C.



One of the most important classes of the present day synthetic pesticides is the organophosphorus insecticide of which more than 100 are widely used as agents to combat plant pests and ectoparasites and in part to combat endoparasites of domestic animals. Some of the important advantages of organophosphate compound, as the preferred insecticides of modem era, are the wide spectrum of action on plant pests, high insecticide activity, low persistence, rapid metabolism and poor accumulation in the body of animals.

Investigations into the synthesis of toxic organophosphorus compound as potential nerve gases began during the World War II. The first organophosphorus insecticide, TEPP was developed at Cambridge. In 1941, "Schrader" prepared Schradan which was considered to be the first organophosphorus compound recognized to be a potent insecticide. In 1944 parathion was synthesized. During last two decades the industry has developed many organic trimesters of phosphoric acid and phosphorothioic acid that are still widely used as insecticides (Cremlyn 1978).

Dimethoate

The dimethoate is Organophosphoate, they have the general formula.R Y R & R' – are short chain hydrocarbon
P □ X – R" X & Y – are either sulfar or oxygen R' R" – Is the group that is metabolized

MATERIAL AND METHOD

Experimental Animal

The freshwater female field crab *Barytelphusa guerini* was used as the experimental non– target species model in the present investigation.

Procurement and Maintenance of the Test Species

- *Barytelphusa guerini* is an edible freshwater crab normally inhibiting the paddy fields of Nanded District.
- It makes burrow in soft mud along the edges of the paddy field. It lives in burrows which are partially field with water. These animals can survive longer period on land but they do not inhabit brackish or saline water. They carnivores, feeding on worms, insects etc. and are also cannibals, feeding on younger crabs.
- Crab was collected from paddy field & in and around Nanded district. They were brought to the laboratory and maintained in large glass aquarium containing tap water. They were exposed to natural day–night cycles. The temperature of water 20¯1C in winter and 31¯1C summer.

Method of Heart Rate

- The crabs, *Barytelphusa guerini*, are a freshwater crab collected from the paddy fields of Nanded District.
- The rate of heart beat was noted after exposure interval of hours, 24h, 48, 72 and 96h. The method used as follows:
- The dissected animal body of exposed heart was kept in crab ringer solution to determine the rate of heart beat. The crab ringer contains all the essential components somewhat similar to that of crab haemolymph.
- Crab Ringer Composition:

Sodium sulphate	– 1.5261 gm
Sodium phosphate	– 0.0358 gm
Sodium chloride	– 16.1000 gm
Potassium chloride	– 0.4162 gm
Magnesium chloride	– 0.0804 gm
Glucose	– 0.6000 gm
Distilled Water	– 1000 ml

Preparation of ringer solution was prepared by using annual grade reagent and the pH was to with the help of pH 7.7 tribuffer. The glucose was added to the crab ringer solution just before the use (Posser, 1973). If the ringer is stored in refrigerator, could be used upto 15 days. It is the best quality composition in which the heart maintained a constant beat for 1 to 2hours.

The animals were collected from their natural habitat and acclimatized. Healthy female crabs weighing between 30–50 gm were selected for experimentation to avoid the effect of size and sex (Ambore N.E., 1976).

The heart beat was seen visually. Then the dissected animals were subjected to finger bowl filled with crab ringer and maintained 5 minute to allow the animal to recover from shock affect. The heart beat was noted and time taken 10 min. for each trials. The heart beat was determined in control exposure of two chemical like endosulfan and dimethoate.

The plotted graphical interpretation has been given the nature of toxicant and their intensity.

RESULT AND OBSERVATION

Observation

Endosulfan

Effect of Endosulfan causes changes in Heart Beats. Heart Beats expressed in Beats/min. is the average of six observation ± S.D.

Table 1: Effect of Endosulfan on Heart RateBeats infemale crab *Barytelphusa guerini.*

Sr.No.	Duration of Exposure	Control	Experimental
1	24	36.03 ± 0.225	29.15 ± 0.468**
2	48	35.28 ± 0.286	39.11 ± 0.325***
3	72	37.06 ± 0.197	31.31 ± 0.223***
4	96	35.11 ± 0.183	25.95 ± 0.152***

Note
1) Values expressed as Beats/min. of animals.
2) Each value is mean of six observations ± S.D.
3) Value are significant at * = P<0.05, ** = P < 0.01, ***=P < 0.001 & NS – **Not significant**

Dimethoate

Effect of Dimethoate causes changes in Heart Beats. Heart Beats expressed inBeats/min. is the average of six observation ± S.D.

Table 2: Effect of Dimethoate on Heart Rate Beats infemale crab *Barytelphusa guerini.*

Sr.No.	Duration of Exposure	Control	Experimental
1	24	21.01 ± 0.098	25.11 ± 0.075*
2	48	21.08 ± 0.090	27.55 ± 0.055**
3	72	21.53 ± 0.072	31.83 ± 0.052**
4	96	22.16 ± 0.046	26.51 ± 0.059**

Note:
1) Values expressed as Beats/min. of animals.
2) Each value is mean of six observations ± S.D.
3) Value are significant at * = P<0.05, ** = P < 0.01, ***=P < 0.001 & NS – Not significant

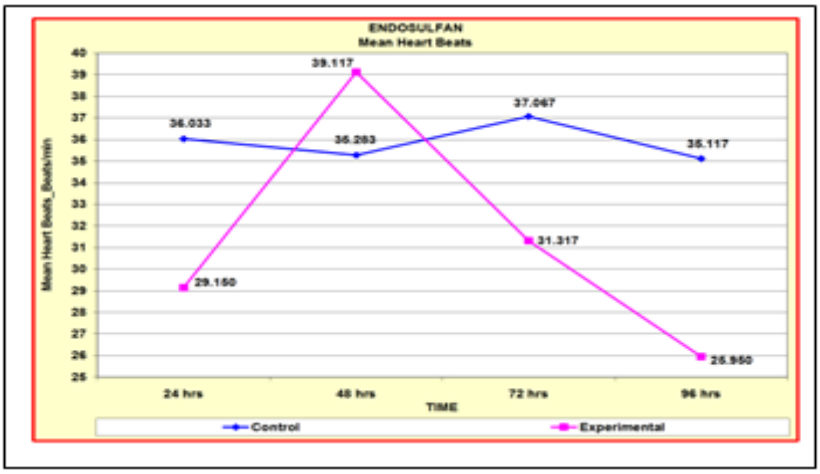


Figure 1: A) Effect of Endosulfan on Heart Rate Beats In *Barytelphusa guerini.*

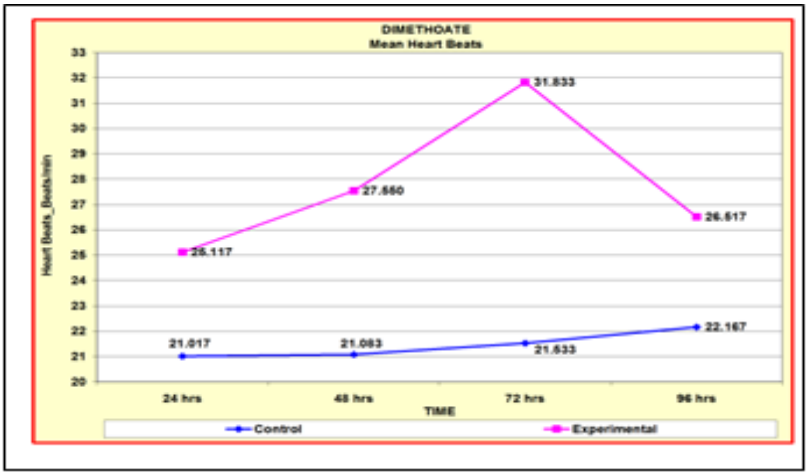


Figure 2: A) Effect of Dimethoate on Heart Rate Beats In *Barytelphusa guerini.*

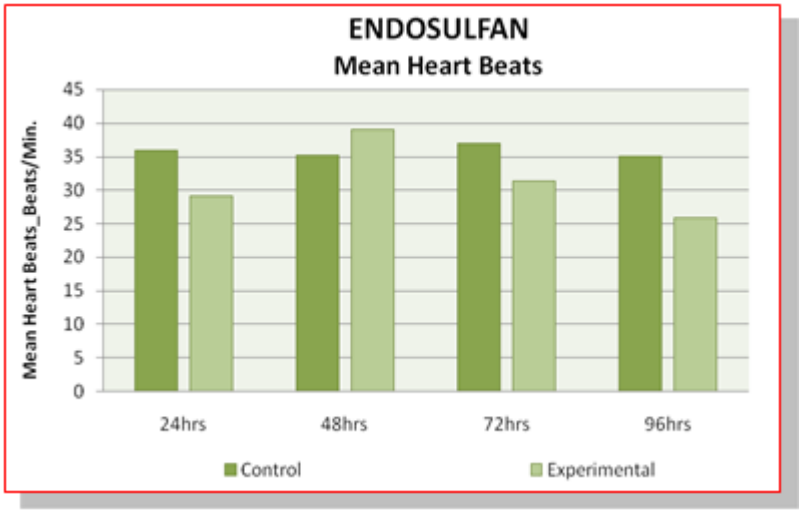


Figure 1: B) Effect of Endosulfan on Heart Rate Beats in*Barytelphusa guerini* (Each value is the mean of six observations ± S.D.)

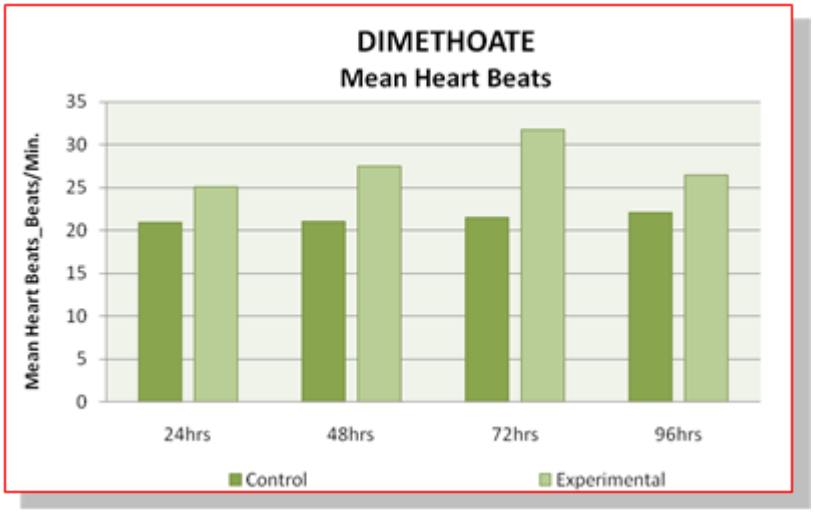


Figure 2: B) Effect of Dimethoate on Heart Rate Beats in *Barytelphusa guerini* (Each value is the mean of six observations ± S.D.).

RESULT

- In present investigation when freshwater female crab, *Barytelphusa guerini* were exposed to two pesticides such as endosulfan and dimethoate. A significant change in heart rate was noticed. The results of experiments conducted are presented in Table 1& 2 and graphical representation for each pesticide illustrated in Figure 1(A & B) and Figure 2 (A & B)respectively.
- When crabs exposed to lethal concentration of endosulfan, a significant decrease in rate of heart beat was observed at 24 hours. From 24 hours it increase upto 48 hours then significant decrease was observed at 72 hours & it slow down at 96 hours.
- After the treatment of dimethoate, rate of heart beat significantly varies than result from endosulfan exposed animal. It show slight increase in rate of heart beat initially at 24 hours further the heart rate accelerated upto 72 hours and again decline at 96 hours but not upto 96 hours as compared to control.
- In endosulfan & dimethoate solution, the heart beat was accelerated at 48 hours & 72 hours simultaneously. Increase in heart rate due to increase in metabolic activity of heart at cellular level and nervous level because of shock of toxicant & stress on normal physiology of circulation. But later on it gradually recover, after the end of exposure the heart rate tends to normal.

DISCUSSION

Environmental pollutants brings about the damage to different organs of disturb the physiological and biochemical processes of the organism following exposure to pollutant. Effects of different pesticides, inorganic ions, drugs and antibiotics on crustaceans hearts specially crabs have been used by many workers to reach the details about adrenergic and choliergic property of crustacean heart (Agrawal *et al.*, 1965). Some important contributions have been made regarding cardio-vascular system by in land crab *Gecarcinus lateralis.* Likewise some other (Hume and Belind, 1976)

have been studied about cardiovascular system in crab *Caricinus maenas*.

Heart beat frequency has been studied in many crustacean species and there is correlations within environmental stress may be due to toxicants and an increase in rate of heart beat as any stress has direct effect on metabolic or consequently heart rate (Makhdoom and Chintawar, 2000).

The activity of heavy metals, pesticides and some other chemical pollutants is stress on the non-target organisms, which causes alteration in their normal physiology and also anatomy. Because of such metallic stress, it acts the normal cardiac physiology of all aquatic animals. The terminology in the physiology of stress has been confusing because some refer to so as the cause of responses such as thermal stress. Other workers call the responses themselves stress i.e. the animal is showing physiological stress and the causes become known as stressors. Any change to come over the stress needs energy, generally different sources of energy metabolism are aquatinted by the organism to encounter the stress. The metabolic cycle involved that are responsible for the production of energy, which undergo a drastic change such a change can determine whether the animal develops the necessary potential to counteract the stress.

It is known that the heart rate naturally increases when the animals become more active. While the heart is occasionally indicate a measure of metabolic state of the animal studies on rate of heart beat which could read the velocity of blood circulation, hence the rate of supply of blood glucose should necessarily be undertaken. The velocity of blood circulation depends on the rate of heart beat and it is known that in all vertebrates, the blood glucose level corresponds to the standard metabolic rate. Therefore the rate of heart indirectly reflects the rate of supply of blood glucose the ultimate source of energy for cellular metabolism.

Present investigation was undertaken to study the effect of two pesticide endosulfan and dimethoate on the heart rate of the freshwater female crab *Barytelphusa guerini*.

The result clearly reveal that the effect of pesticides, initially decline and heart rate. This indicate animal try to settle down into the toxic medium and further effects of toxicant increases the metabolic activity increases the rate of heart beat in crab.

CONCLUSION

- The pesticide pollutants plays important role on the aquatic biota including fishes and crustaceans like crabs. The animals were exposed to sublethal concentration of pesticide pollutants and effect of Endosulfan and Dimethoate on heart beat was studied in Freshwater female crab *Barytelphusa guerini*. As compaired with control, the heart rate was initially decreased on exposure to Endosulfan and increased to Dimethoate.
- The crabs exposed to sublethal concentration of Endosulfan showed decrease at 24 hours, increase at 48 hours, decrease at 72 hours and decline at 96 hours. Dimethoate increases the heart beat at 24 hours reaches pick point at 72 hours and decreases at 96 hours.
- It concluded that heartbeat of crabs increases and decreases depending upon the specific type of toxicant and time.

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