ORIGINAL ARTICLE

EFFECT OF ENDOSULFAN ON THE BLOOD GLUCOSE LEVEL IN THE GARDEN LIZARD, CALOTES VERSICOLOR (DAUD.)

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ABSTRACT

The present study is aimed to investigate the effect of endosulfan on the blood of garden lizard, Calotes versicolor. In the present study, the level of blood glucose was observed on the median lethal dose of endosulfan (41.7 mg/kg body weight) for 6, 12, 18, 24, 48, 72, 96 and 120 hours of exposure and lethal dose of endosulfan (59.7 mg/kg body weight) for 6, 12 and 18 hours of exposure. The present study showed the level of blood glucose was decreased in the blood of garden lizard, Calotes versicolor.

Key words: Endosulfan, Blood Glucose, Calotes versicolor

1. INTRODUCTION

A wide range of toxic chemicals called pesticides are used to control or eradicate the pests of agriculture, horticulture and other different crops throughout the world by man. The uses of pesticides have served to improve our crops from the ravages of insect pests. Control of pests have always been one of the major factors in enhancing the agricultural production (Hague and Freed, 1975).

The synthetic group of pesticides are broadly classified into three major groups viz., Organochlorines, Organophosphorus and Carbamates (Corbett, 1973). Among them organochlorine pesticides are commonly used in agriculture due to their high effectiveness in reducing the pests even at low concentrations. The organophosphorus compounds dichlorvos, monocrotophos, parathion, fenitrothion, malathion, phosalone, dimethoate, thionetetol are degradable and are quickly broken down into harmless products in the milieu. Though they are highly toxic, they are not pollutants if used carefully, whereas the carbamate compounds isolan, carbaryl, carbofuran, aldicarb, carbathion are least in their toxicity. Among the organochlorine compounds DDCT, aldrin, lindane, dieldrin, endrin, chlordane and heptachlor are remarkably long lasting chemicals in the milieu. For instance, residues of DDCT and some other pesticides have been reported to be found even after 12 years from their day of application and thereby causing biomagnification.

Blood plays an important role in the normal functioning of the body of any organism. Seasonal variations in the blood contents of reptiles have been reported by Hutton and Goodnight (1957), Binyon and Twigg (1966), Kekic (1970), Banerjee and Banerjee (1969) and Choubey (1975).

Blood glucose levels have been reported to be a sensitive indicator of many stresses viz., handling, forced activity, salinity changes and few chemical pollutants (Ghosh et al., 1969; Wedemayer, 1972; Silbergeld, 1974 and Watson and Mckeown, 1976). A definite seasonal variation in the blood glucose level has been reported to occur in reptiles (Dessauer, 1953). Pancreatectomy affects the blood glucose differently in different reptiles (Housay and Penhos, 1960; Madhavan and Rangnekar, 1985). The effect of Cad	extsuperscript{2} on the cells of endocrine pancreas in the snake, Natrix natrix was worked out by Calugrenan (1970). Light and electron microscopic studies on pancreatic islets of the lizard, Lygosoma laterale was observed by Rhoten and Williams (1971). Hussaini and Amani (1976) studied the effect of intramuscular injections of two different doses of allophan on the pancreatic islet tissue and the blood sugar level of the toad, Bufo regularis and the lizard, Agama stellio at different time intervals.

An interesting study was made by Chan et al. (1970) on the water and electrolyte composition of the Iguanid lizard, Diposaurus dorsalis with reference to the control in the pituitary gland and the adrenal cortex. Lofth et al. (1971) have observed the seasonal changes In the histology of the adrenal gland of the Cobra, Baja naja. Unsicker (1974) has investigated the innervation of adrenal cells in the lizards, Lucerta dugesi and Lucerta ptychanteri. Contiguity of the adrenaline-sorring chromaffin cells with the internal tissue in the adrenal gland of a lizard was worked out by Conte (1977).

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2. MATERIALS AND METHODS

Procurement, acclimatization and selection of the experimental animals

The experimental animals were live trapped in and around Mannampandal area. The collected experimental animals were lodged in cages of 18 x 18 x 45 cms size and were acclimated for a week. They were nourished with live cockroaches, grasshoppers and butterflies. Water was placed ad libitum.

Only the female animals of Calotes versicolor were taken for the present study. Healthy individuals weighing about 30 - 37 gms were selected for the control and the experimental studies. Much care was taken to avoid injured, pregnant and infected animals.

Chemical and physical properties of the selected pesticide

In the present study endosulfan (99% technical grade), α,β - 1, 2, 3, 4, 7, 7 - Hexachloro bicyclo -(2, 2, 1) heptene - (2)- bisoxymethylene - (5, 6) sulphite supplied by Bharat Pulverising Mills (Private Limited), Bombay was used (Source: Mercier, 1981).

Toxicity studies

The toxicity tests have been classified into different categories based on the types of pollution in the environment as preliminary screening tests and tests to establish water quality criteria, etc. In the laboratory, determinations of toxicity may be divided into two types viz., short term or acute toxicity tests and long term or chronic biological responses (Nogilski, 1975).

Range finding tests

To avoid much time delay and effort the preliminary exploratory tests were conducted to get a range but not an accurate dose of the pesticide, which should be covered in the full scale tests. To conduct these tests, 1% stock solution of the pesticide, endosulfan was prepared by dissolving it in the coconut oil. Test solutions of required concentrations were prepared from the stock solution.

Lizards were orally administered with 1.0 ml of the pesticide solution, containing the required dose of pesticide by using hypodermic syringe without the needle. Much care was taken to avoid regurgitation of the pesticide. The exploratory tests showed the range of toxicity for this pesticide ho this experimental animal between 41.7 to 59.7 rag/kg body weight.

Full scale tests

Based on the exploratory tests, full scale tests were conducted to assess the acute toxicity of the selected pesticide, endosulfan. In these tests seven concentrations viz., 41.7, 44.7, 47.7, 50.7, 53.7, 56.7 and 59.7 mg/kg body weight were administered and for each concentration six lizards were used. Simultaneously the control animals were maintained and they were administered with 1.0 ml of coconut oil by using hypodermic syringe without the needle. The control and experimental lizards were observed for 120 hours. None of the control individuals attained mortality. In the pesticide treated lizards, the mortality rate of the lizards were observed at different hour’s viz., 6, 12, 18, 24, 48, 72, 96 and 120. The dose at which 50% mortality attained for a period of 120 hours was taken as median lethal dose (120 hours, LD_{50}) and the dose at which cent percent mortality attained in the test animals for a period of 24 hours was taken as lethal dose (24 hours, LD_{50}) for the present study.

From the observed results, it was inferred that the pesticide concentration of 41.7 mg/kg body weight at which 50% mortality occurred for 120 hours was taken as median lethal value (120 hours, LD_{50}) and the pesticide concentration of 59.7 mg/kg body weight at which cent percent mortality occurred for 24 hours was taken as lethal dose value (24 hours, LD_{50}).

Calculation of LD_{50} value

The LD_{50} was estimated by the method of Litchfield and Wilcoxon (1949). The LD_{50} value was obtained by the straight line interpolation method based on observed percentages of test animals surviving at concentrations lethal to more than half and less than half of the test animals. The LD_{50} value was derived by plotting the experimental data on a one scale log x probability sheet taking test concentration on the probability scale. A straight line was drawn between the points representing the mortality percentages Vs concentration (Standard methods published by American Public Health Association, 1960). From the point at which this line intersects 50 percent mortality, a perpendicular line was drawn to the concentration marked in ordinate and this indicate the LD_{50} of 120 hours exposure period.

Estimation of blood glucose

Blood glucose was determined by the method of Murrel and Nace (1958). The Blood samples (0.01m) were collected by caudal puncture using heparinized hypodermic syringe and were immediately deproteinized in 10 ml of 10 per cent tungstic acid. The solutions were filtered and the filtrate was used for glucose estimation. 0.5ml of the filtrate and 0.5ml of dilute tungstic acid were taken in a clean test tube and then 1.0ml of potassium ferricyanide solution was added. The test tube was placed in boiling water bath for 15 seconds and cooled in running tap water, when the contents were sufficiently cooled. 1.0ml of cyanide carbonate solution (buffer solution ) was added and the tubes were again placed on boiling water bath for 15 minutes and then quickly cooled to 25-30°C. Then into each tube, 2.0ml of ferric dupanol reagent was added followed by the addition of 6.0ml of distilled water and the solution was mixed well and shaken well after 10 minutes the intensity of blue colour formed was read at 630 nm in a spectrophotometer against the reagent blank. A standard curve was constructed from the absorbance of the standard glucose solution. The unknown glucose values of blood samples were directly read from standard curve. The glucose values are expressed as mg/ml of blood.

Statistical analysis

The data obtained from the control and experimental parameters were analyses to determine the level of significance at various exposure periods by student’t test.

3. RESULTS.

Biochemical studies

The mean blood glucose values of the controls and the median lethal dose treated lizards are presented in the Table 3 and illustrated in the Table 1. The median lethal dose treated lizards had decreasing trend in their blood glucose level when compared to the control values upto 120 hours and later they died. The blood glucose levels of lizards, after administrating with the pesticide, endosulfan
at different hours viz., 6, 12, 18, 24, 48, 72, 96 and 120 were 101.25 ± 7.53 mg/100 ml, 99.96 ± 8.51 mg/100 ml, 95.86 ± 7.41 mg/100 ml, 94.26 ± 6.35 mg/100 ml, 93.19 ± 5.91 mg/100 ml, 90.22 ± 5.91 mg/100 ml, 79.89 ± 6.54 mg/100 ml and 78.17 ± 8.45 mg/100 ml of blood, while the control values were 114.27 ± 5.63 mg/100 ml, 113.40 ± 5.26 mg/100 ml, 113.83 ± 5.73 mg/100 ml, 113.87 ± 6.75 mg/100 ml, 114.10 ± 6.51 mg/100 ml, 114.50 ± 7.35 mg/100 ml, 113.50 ± 6.92 mg/100 ml and 113.64 ± 5.45 mg/100 ml of blood during the respective hours. The difference between the control and the treated lizards were to be significant during all the experimental hours and the ‘t’ values of different hours viz., 6, 12, 18, 24, 48, 72, 96 and 120 were 3.39, 2.76, 3.29, 4.70, 5.89, 5.83, 8.64 and 11.94 (P<0.05) respectively.

### Table 1: Level of blood glucose (mg/100 ml) of *Calotes versicolor* in the control and endosulfan exposed animals at median lethal dose

<table>
<thead>
<tr>
<th>Hours of administration</th>
<th>Control</th>
<th>Endosulfan exposure</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>114.27 ± 5.63</td>
<td>101.25 ± 7.53*</td>
</tr>
<tr>
<td>12</td>
<td>113.40 ± 5.26</td>
<td>99.96 ± 8.51*</td>
</tr>
<tr>
<td>18</td>
<td>113.83 ± 5.73</td>
<td>95.86 ± 7.41*</td>
</tr>
<tr>
<td>24</td>
<td>113.87 ± 6.75</td>
<td>94.26 ± 6.35*</td>
</tr>
<tr>
<td>48</td>
<td>114.10 ± 6.51</td>
<td>93.19 ± 5.91*</td>
</tr>
<tr>
<td>72</td>
<td>114.50 ± 7.35</td>
<td>90.22 ± 5.91*</td>
</tr>
<tr>
<td>96</td>
<td>113.50 ± 6.92</td>
<td>79.89 ± 6.54*</td>
</tr>
<tr>
<td>120</td>
<td>113.64 ± 5.45</td>
<td>78.17 ± 8.45*</td>
</tr>
</tbody>
</table>

Mean± S.D of six individual observations

*Indicates statistically significant at 5% level

### Table 2: Level of blood glucose (mg/100 ml) of *Calotes versicolor* in the control and endosulfan exposed

<table>
<thead>
<tr>
<th>Hours of administration</th>
<th>Control</th>
<th>Endosulfan exposure</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>114.27 ± 5.63</td>
<td>99.43 ± 8.32*</td>
</tr>
<tr>
<td>12</td>
<td>113.40 ± 5.26</td>
<td>92.71 ± 8.36*</td>
</tr>
<tr>
<td>18</td>
<td>113.83 ± 5.73</td>
<td>87.85 ± 7.86*</td>
</tr>
</tbody>
</table>

Mean± S.D of six individual observations

*Indicates statistically significant at 5% level

The mean blood glucose values of the control and the lethal dose treated lizards are presented in Table 4 and illustrated in the Table 2. The lethal dose treated lizards had decreasing trend in their blood glucose levels when compared to the control values upto 18 hours and later they died. The blood glucose levels of lizards, after administrating with the pesticide, endosulfan at different hours viz., 6, 12 and 18 were 99.43 ± 8.32 mg/100 ml, 92.71 ± 8.36 mg/100 ml and 87.85 ± 7.86 mg/100 ml of blood, while the control values were 114.27 ± 5.63 mg/100 ml, 113.40 ± 5.26 mg/100 ml and 113.83 ± 5.73 mg/100 ml of blood during the respective hours. The difference between the control and the treated lizards were statistically significant during all the experimental hours and their ‘t’ values were 5.09, 6.12 and 8.65 (P<0.05) at 6, 12 and 18 hours respectively.

### DISCUSSION

Blood glucose has been a sensitive biochemical indicator of environmental stress persuaded by handling, forced activity, thermal shock, contact with pesticides and other chemical pollutants (Chavin and Kavacevic, 1961; Nakano and Tomlinson, 1967; Hill and Fromon, 1968; Watson and Mckeown, 1976; Wedemayer and Yasutaka, 1977 and Mcielev et al., 1983). The blood glucose level which shows fluctuations represent a dynamic balance between the rate at which it enters the blood from the liver and the rate at which it is being removed by the body tissues from the blood for utilization (Saskin, 1941). In the present investigation, the normal blood glucose level was estimated in the laboratory acclimated lizards and its mean value was 114.5 ± 7.35 mg/100 ml of blood. Khanna and Kumar (1975) have stated that the lizards generally maintain a much higher level of blood glucose than do other reptiles. The present findings gain support from the findings of Dessauer (1952) for Gekko gekko, Dessauer (1953) for Anolis carolinensis, Miller and Wruster (1958) for Eumeces obsoletus, Dawson (1960) for Eumeces obsoletus, Dawson and Poulson (1962) for Phrynosoma cornutum, Metelica and Constanta (1965) for Lacerta viridis viridis, Sabnis and Rangnekar (1967) for Varanus monitor, Calotes versicolor and Nabuya carinata, Khanna and Kumar (1974) for Uromastix hardwici and Madhavan and Rangnekar (1985) for Calotes versicolor.

In the present study, it was documented earlier that the lizards administered with mean lethal and lethal doses of endosulfan exhibited gradual decrease in their blood glucose level, when compared to control level. Similar results were reported for different species. Paul Ravidran (1989) also recorded a decreasing trend in the blood glucose level of R. tigrina. Balakrishnan (1989) has been reported in the rat, Bellardia melitana administered with lindane showed the decreased blood glucose level. A decline in the blood glucose level was also found in the bird, Lomchi maculata administered with endosulfan (Usha, 1990). Neelanarayanan (1990) observed a similar decreasing trend in the blood glucose level in Bellardia melitana when they poisoned with zinc phoshide. The present findings also gain support from the works of Mazaeza et al., (1971) for different fishes and aquatic organisms. Jawale (1985) has observed for the freshwater fish, Rasbora daniconius on exposure to lethal concentration of the pesticides like DDT, endosulfan, malathion and dimercron, the fish showed a sudden fall in its blood glucose level which resulted in its death. Similar results were observed for Anabas testudineus administered with lethal concentration of malathion has been reported by Amaudha (1986). Mazaeza et al. (1971) have stated that when an animal was exposed to pesticides, which gives heavy stress on the animal and such stressful condition elicits neuro-endocrine responses in the organisms, which in turn affect the carbohydrate metabolism.

The rapid fall in the blood glucose level found in the present study might be due to the severe stress which occurred on the animal during the initial phase of anoxia. Wilhelmi (1948) was of the opinion that under fully developed shock, the blood glucose level falls and then there is striking rise in the ratio of lactate to pyruvate and that the combination of an increased rate of utilization of carbohydrate. Engle (1949) has also stated that stress regularly results in hypoglycemia and death in cases where the adrenal cortex fails to function. It may be concluded that hypoglycemia in treated animals may be either due to failure of the adrenal to secrete the adrenocorticotid secretion or due to the damage caused in the adrenal due to the administration of the pesticide. The fall in the blood glucose level much below its normal threshold value resulted in hypoglycemic convulsions which might have caused the death of the treated animals while hyperglycemia has been reported for *C. versicolor* when administered with lindane (Thiyagesan, 1981) and when administered with malathion (Rajeswari, 1988). They have accounted hyperglycemia as due to the increased secretion of glucocorticoids.

### REFERENCES


Paul Ravindran, A.S. 1989. Effects on malathion on the islets of Langerhans, adrenal glands and blood glucose


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