RESEARCH ARTICLE

BIOCHEMICAL ALTRATIONS IN DNA CONTENT OF GILL AND GONAD TISSUES OF *LAMELLIDENS MARGINALIS* DUE TO DOXORUBICIN TO TOXICITY

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Abstract:

The present study investigates the effect of doxorubicin on DNA content in the gill and gonad tissues of the freshwater mussel *Lamellidens marginalis*. Doxorubicin is a widely used chemotherapeutic agent known for its cytotoxic and genotoxic effects. The experimental organisms were exposed to doxorubicin, and DNA content was analyzed on the 15th and 30th days of exposure. The results revealed a significant decrease in DNA content in the gill tissue, declining from 2.23 ± 0.059 to 1.98 ± 0.094 on the 15th day, with a further reduction observed on the 30th day. Similarly, gonadal DNA content showed a marked decrease from 1.75 ± 0.113 to 1.41 ± 0.0896 on the 15th day, and from 8.16 ± 0.951 to 7.16 ± 0.256, followed by a further decline from 7.33 ± 0.654 to 5.80 ± 0.258 on the 30th day. These reductions indicate significant DNA damage and cellular degradation caused by doxorubicin exposure. The observed decline in DNA content may be attributed to oxidative stress, tissue degeneration, and increased metabolic utilization of cellular components. This study highlights the toxic effects of doxorubicin on freshwater mussels and emphasizes its potential ecological risk to aquatic organisms.

Keywords: Doxorubicin Toxicity, DNA Content, Gill and Gonad Tissues, *Lamellidens marginalis*, Genotoxic Effects.

Introduction:

Biochemical responses may serve as a defensive mechanism of the body to withstand and combat the toxic effects of pollutants such as heavy metals and their derivatives. It is also observed that certain biochemical alterations occurring in the body provide early warning indications of stress conditions. However, these alterations may also have serious side effects, which need to be studied using appropriate biological systems. Properly applied biochemical modulation schedules may contribute to successful clinical applications (Peter, 1991). Pollutants, including heavy metals, can

modify cellular functions and ultimately affect the physiological and biochemical mechanisms of animals. It has been reported that heavy metals can cause various biochemical changes such as enzyme inhibition, metabolic disorders, genetic damage, hypertension, and cancer (Underwood, 1971; Zemasky, 1974; Lucky and Venugopal, 1977).

In light of the above facts, *Lamellidens marginalis* was selected for biochemical studies under sublethal concentrations of doxorubicin for both subchronic (15 days) and chronic (30 days) exposure periods.

Materials and Methods:

Attempts were made in this study to select freshwater bivalves, *Lamellidens marginalis*, which were collected from Kurla Dam, located about 5 km from Mahad city in Maharashtra State. The collected specimens were first acclimatized to laboratory conditions and thoroughly washed. The water in the aquaria was changed regularly every 24 hours.

After acclimatization, the bivalves were divided into two groups with equal numbers of animals. They were maintained in separate aquaria for 15 and 30 days. One of the groups was treated with a chronic concentration of doxorubicin, corresponding to $LC_{50}/10$ of the 96-hour LC_{50} value (0.836 ppm).

On the 15th and 30th days of exposure, bivalves from each experimental group were sacrificed, and the gill and gonad tissues were removed. These tissues were dried in an oven at 75°C to 80°C until a constant weight was obtained and then ground into a fine dry powder. The powdered samples were used for the estimation of biochemical components of RNA to evaluate the efficacy of doxorubicin.

Results and Discussion:

The above Experiment has concluded that the result obtained on 15 and 30 days of gill, and gonad with doxorubicin are as follows:

15 Days Treatment Period (Subchronic)

The gill and gonad of *Lamellidens marginalis* showed a significant decrease ($P < 0.01$) in DNA content following doxorubicin treatment. In the gill tissue, the DNA content decreased from 2.23 ± 0.059 mg/g wet tissue in the control group to 1.98 ± 0.094 mg/g wet tissue in the treated group. The total DNA content in the gill and gonad showed a decrease ranging from 11.21% to 12.25%.

Similarly, the total RNA content in the gonad showed a significant decrease from 8.16 ± 0.951 mg/g wet tissue in the control group to 7.16 ± 0.256 mg/g wet tissue in the treated group, representing a decrease of 11.21%. In both gill and gonad tissues, a statistically significant decrease in nucleic acid content was recorded following doxorubicin exposure.

30 Days Treatment Period (Chronic)

The total DNA content of gill and gonad tissues in control *Lamellidens marginalis* was assessed and compared with doxorubicin-treated specimens. The results obtained on the 30th day after treatment showed a significant decrease in DNA content in the gill, from 1.75 ± 0.113 to 1.41 ± 0.0896 mg/g wet tissue. Similarly, the gonad tissue also showed a significant decrease in DNA content, from 7.33 ± 0.654 to 5.80 ± 0.258 mg/g wet tissue following doxorubicin treatment.

The results of subchronic exposure (15 days) and chronic exposure (30 days) revealed that both gill and gonad tissues exhibited significant depletion in DNA content, with greater reduction observed

during the longer exposure period. The comparative study clearly indicates that prolonged exposure to doxorubicin results in marked depletion of DNA levels in both tissues.

A wide variety of chemotherapeutic drugs are used to treat cancer; however, many organic compounds show limited efficacy due to problems related to drug delivery and resistance. Doxorubicin is a conventional chemotherapeutic agent that binds covalently to purine bases of DNA and induces cellular apoptosis (Kerbel, 1997). A better understanding of the downstream cellular targets of doxorubicin provides insight into its mechanism of action and helps explain the development of drug resistance. Doxorubicin causes cytotoxicity primarily through DNA damage and interference with DNA function, leading to inhibition of cell proliferation and death of malignant cells, including sarcomas (Gately *et al.,* 1993).

Table 1: Alteations in the DNA content mg/100mg dry weight+ S.E. in digestive gland, and foot tissues of *Lamellidens marginalis* Treatment with doxorubicin

Sr. No.	Tissues	Days	Control (mg/g wet tissue)	Experimental (mg/g wet tissue)	Student 't' test 'p' value	% increases (+) or decreases (-)
1	Gill	15	2.23 ± 0.059	1.98 ± 0.094*	P < 0.01	-11.21%
		30	1.75 ± 0.113	1.41 ± 0.0896*	P < 0.01	-19.42%
2	Gonad	15	8.16 ± 0.951	7.16 ± 0.256**	P < 0.01	-12.25%
		30	7.33 ± 0.654	5.80 ± 0.258**	P < 0.001	-18.14%

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