ROLE OF ASCORBIC ACID IN THE TOXICITY OF PESTICIDES IN A FRESH WATER TELEOST

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Abstract. The effect of ascorbic acid and pesticides (thiotox and malathion) on certain haematological parameters of a fish Saccobranchus fossilis was studied. The sublethal concentrations of thiotox (0.002 mg l⁻¹) and of malathion (5.2 mg l⁻¹) were tested. Ascorbic acid (2 mg 100 g⁻¹ body weight) was given with food. The alterations in haematological parameters (CT, PT, Hb, RBC, WBC, ESR, PCV, MCH, MCHC, MCV, glucose, protein, total P, Na, K, Mg, Ca, and Cl) were measured after 15 and 30 days exposure. Thiotox and malathion induced significant alteration in blood parameters while ascorbic acid played a protective role.

1. Introduction

Blood takes part directly or indirectly in almost all the activities of fish and thus it can be a good indicator of stress conditions (Verma et al., 1979; Bansal et al., 1979). Pesticides affect the various haematological parameters in fish (Verma et al., 1979; Bansal et al., 1979; Gupta, 1980). The protective role of ascorbic acid was pointed out by Agrawal et al. (1978) for pesticides, and Fox and Fry (1970) for heavy metal toxicity. The present study was designed to investigate the effects of sublethal concentrations of thiotox and malathion on certain haematological parameters of a fish Saccobranchus fossilis and the role of ascorbic acid in the toxicity of these pesticides.

2. Materials and Methods

Specimens of S. fossilis were collected from neighboring ponds and kept in aquaria (2 × 2 × 1 m). The fish ranged between 19 and 22 cm in length and 50 and 70 g in weight. Commercial grades of pesticides, thiotox (35 EC) supplied by Pesticides (India) Ltd., Udaipur and malathion (50 EC) of M/s Bayer India Ltd., Bombay, were used. Ethanol : aceton (1 : 1 v/v) mixture was used as the solvent for preparing the stock solutions of pesticides.

After the normal process of acclimatization and washing with 0.1% KMnO₄ solution, four experiments were set up:

(i) Fish were given a diet and kept in water without any pesticide solution.
(ii) Fish were given a diet with ascorbic acid and kept in water without any pesticide.
(iii) Fish were given a diet without ascorbic acid and kept in pesticides solution.
(iv) Fish were given a diet with ascorbic acid and kept in pesticides solution.
In each experiment 20 fish were used. At least 1 l water/solution was available for each 2 g body weight of fish. Ascorbic acid (2 mg 100 g⁻¹ of body weight) was added to the diet every third day. The concentrations of pesticides were prepared adopting a dilution technique as given in Standard Methods (APHA et al., 1971). The water/solution was renewed after each 24 h to remove debris etc. In each experiment 10 fish were sacrificed after 15 and 30 days. The blood samples of controls as well as of treated fish were pooled into vials containing disodium/potassium salt of EDTA as anticoagulant by severing caudal peduncle and stored in a refrigerator for analysis. However, blood for red blood cells (RBC), white blood cells (WBC) counts, haemoglobin percentage (Hb%), and clotting time (CT) was taken directly from caudal peduncle following the recommendation of Wintrobe (1967).

Hb was measured using Sahli’s haemometer, packed cells volume (PCV) or hematocrit value by Wintrobe’s method (3000 rev min⁻¹ for 1 h); RBC and WBC counts by Neubauer’s double hemocytometer using Hayem’s and Tuerk’s diluting fluid, respectively; Erythrocyte sedimentation rate (ESR) by westergren’s tube method; clotting time (CT) by the Lee and White method; and prothrombin time (PT) by Quick one stage method. The mean corpuscular haemoglobin concentration (MCHC) and mean cell volume (MCV) were calculated using the formulae given in ‘Practical haematology’ by Dacie and Lewis (1963).

Glucose was determined by the ‘Nelson-Somogi method’; plasma proteins by the Micro-Kjeldahl method; K by the Looney and Dyer method; Mg by the Titan Yellow method; Ca by the Clark-Collip modification of Kramer-Tisdall method; Chloride by the Schales and Schales method; and P was determined as given by Oser (1965) in Hawk’s physiological chemistry.

The Fisher’s ‘t’ test (1950) was employed to calculate the statistical significance between control and experimental values.

3. Results and Discussion

The alterations in the haematological parameters induced by both the pesticides individually and with ascorbic acid are presented from Tables I to IV. It is obvious from these results that the differences in haematological parameters between the fish of experiments (i) and (ii) are insignificant, indicating that the ascorbic acid had little effect on these parameters. A significant change was observed in haematological parameters of the fish of experiment (iii). The changes on these haematological parameters as compared to experiment (i) were much less for the fish of experiment (iv) as compared to experiment (iii). Thus, it can be concluded that ascorbic acid reduces the toxicity of these pesticides.

In general, haematological parameters like CT, ESR, MCH, MCV, and protein contents were found to be decreased, while PT, Hb, RBC, WBC, PCV, glucose, P, Na, K, Mg, Ca, and chloride were found to be increased after exposing the fish to both the pesticides for either time intervals. The increase in Hb, PT, RBC, WBC, glucose, total P, Na, and chloride, and the decrease in CT, MCH and MCV were found to be